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Double Pitman Open-back Press.

We illustrate on this page a press of new and special design, known as the "Stiles" double pitman open-back press. The press is intended especially for use in manufacturing articles where consecutive operations are performed upon the same piece of work, which is often handled entirely by automatic devices which are attached to the presses, but are not shown in the engraving. It is adapted, for instance, to such work as making satchel lock frames, where a series of holes are punched in the sheet, which is then carried along under the blanking punch, and the blank punched, after which by automatic attachments (not shown in the cut) this is carried under the shaping punch and formed into proper shape, in this way accomplishing three operations at each stroke.

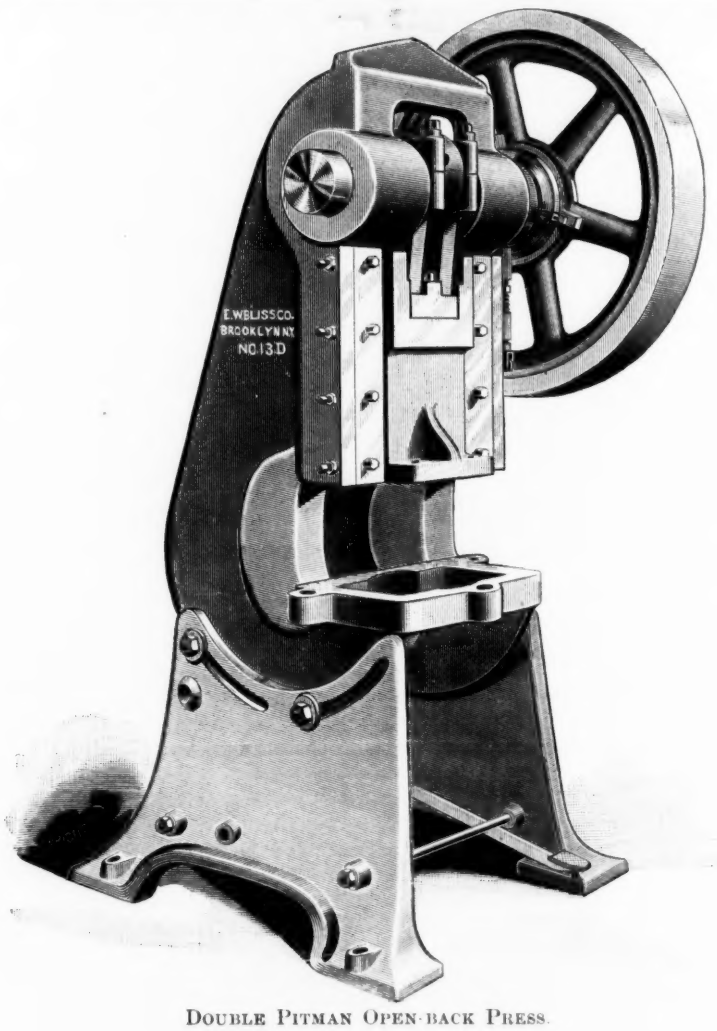
The press can also be used for a great variety of other similar work, such as blanking, forming, shaping, perforating, etc.

The two pitmans are so arranged that the well-known eccentric adjustment is easily applied, giving a solid action from the shaft to the slide. Feed rolls and automatic devices can be easily attached to this style of machine.

The frame of the press is so arranged that it can be inclined, which is a feature specially valuable where combination cutting and forming dies are used, as the frame being open back the work falls through and from the machine by gravity.

The shaft is fitted with an automatic clutch which is operated with a foot treadle in the usual manner. Some of the standard dimensions are as follows: The weight of fly-wheel is 725 pounds, diameter 38″, face 5½″, stroke 1½″; distance from bed to end of slide when up, 9″; opening in bed, 8″x12″; weight complete about 3,000 pounds. These dimensions can be modified to suit special requirements.

The press is made by the E. W. Bliss Co., No. 1 Adams street, Brooklyn, N. Y.



DOUBLE PITMAN OPEN-BACK PRESS.

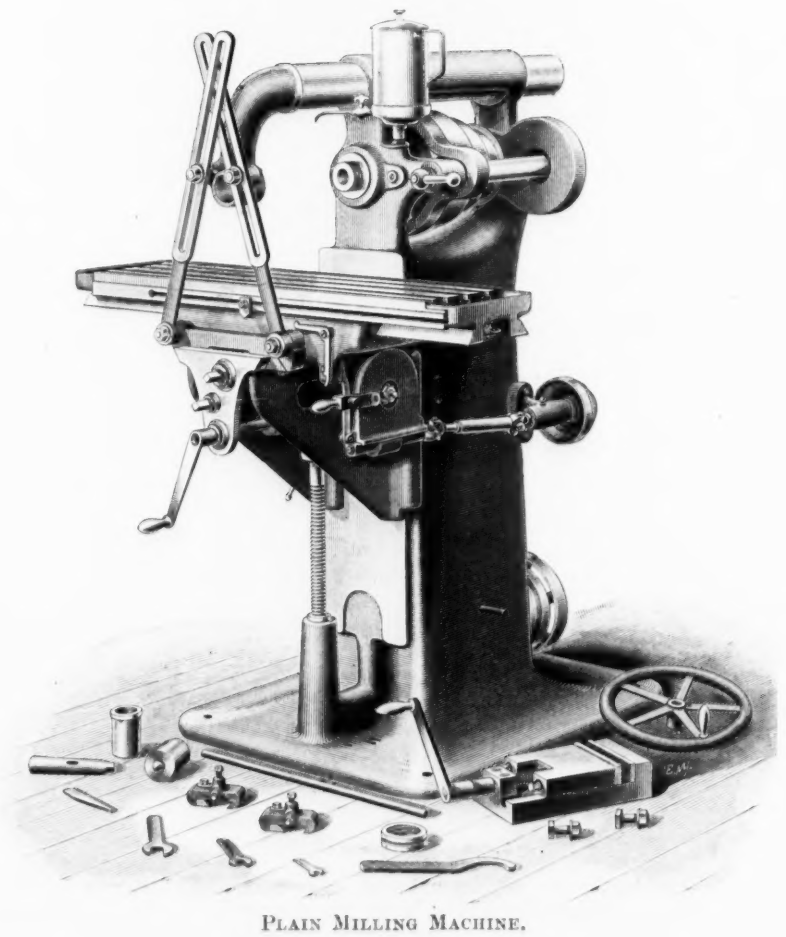
Plain Milling Machine.

The accompanying illustration is of a new design of plain milling machine, which in its general features resembles the universal machine by the same builders, but is without the index head, and has no swivel to the platen. This latter feature, of course, adds to the stiffness as compared with the universal machine, because the platen slides directly upon the saddle, in a broad and long bearing.

As the machine is designed for heavy cuts, many of them in manufacturing operations involving repetitions, a method is provided for attaching the outer end of the overhanging arm firmly to the knee, thus adding very much to the rigidity of the arbor support.

The spindle has a hole its entire length and runs in bronze boxes provided with means of compensation for wear. The front end is threaded and has a hole fitted for arbors with taper ½ inch per foot and 1.05 inches diameter at the small end.

The cone has three steps, the largest 10 inches diameter, for 3-inch belt and is back-geared, giving six changes of speed. The gears are covered.



PLAIN MILLING MACHINE.

The overhanging arm has a hole for a center, or for a bearing for outer end of arbor, etc. It can be easily reversed to receive an attachment, turned out of the way, or removed. The distance from the center of the spindle to the arm is 5½ inches; greatest distance from end of spindle to center in arm, 16 inches.

The table, including oil pans and channels, is 40 inches long, 10 inches wide and has a working surface 34 inches x 10 inches. It also has three T-slots ⅝ inch wide, a transverse movement of 6½ inches and can be lowered 18½ inches from center of spindle. The feed of table, 28 inches, is automatic in either direction and there are 12 changes of feed varying from .005 inch to .13 inch to one revolution of spindle.

Adjustable dials graduated to read to thousandths of an inch indicate the transverse and vertical movements of table, and these dials may be adjusted without the aid of wrench or screw driver.

The frame is hollow and fitted as a closet to hold the small parts that accompany the machine. On the left side there is a pan for holding small tools, etc, and on the front of this there is a rack for wrenches.

The vise has jaws 6⅛ inches wide, $1\frac{7}{8}$ inches deep and will open 3⅝ inches.

The machine is typical of a line of similar ones of varying capacities the particular machine described requiring a floor space 68 inches x 45 inches and weighing about 1,645 pounds. It is made by the Brown & Sharpe Mfg. Co., Providence, R. I.

The Metric System in Engineering Work.

It is becoming increasingly evident that so far as regards competition with European countries in the neutral markets of the world, our awkward system of weights and measures places us at a decided disadvantage. Our foreign consuls are repeatedly drawing attention to the fact that the metric system, employed generally except in this country, is the system of measurement which should be used if our traders are to be placed upon an equal footing with those of France and Germany. But this is not the only aspect of the question. Probably more calculations are made in weights and measures in engineering than in any other trade or profession, and engineers are, or should be, specially interested in this important matter. There can be no reasonable objection to the adoption of a system by which so much time and labor would be economized, except on the score of inconvenience, which, however, would be only a temporary disadvantage. Mr. F. H. Livens has recently demonstrated, by practical examples, how great is the saving effected by adopting the metric system in estimating for engineering work. The meter as a unit might be considered long, as compared with our foot, but the centimeter is most suitable for general engineers' dimensions, whilst there is no comparison between reckoning in millimeters against 16ths and 32nds of an inch. The system affords the most simple relations between the units of length, weight, and capacity; and the identity for practical purposes of the liter and cubic decimeter, and of their volume in water with the kilo-

gramme, is of special advantage for engineers' computations. For scientific purposes, the metric system has come to be regarded as a necessity, and Messrs. Willans and Robinson, who have recently adopted it in their engineering works at Thames Ditton, state that no difficulty has been caused by the change, that there are now no errors, and that the workman obtains a better idea of proportion when working with the metric denomination.—*Mechanical World* (Manchester).

Grant's Epicycloidal Bevel Gear Generator.

The engraving below illustrates George B. Grant's "planoider," a machine for generating the theoretically perfect epicycloidal tooth on bevel gears, of which he writes as follows:

The particular form of the epicycloidal tooth adopted is called the "planoid" to distinguish it from other forms, and it is believed to be the only form of bevel gear tooth that can be generated in a practical and economical manner by a rotary milling cutter. It is the form having plane radial flanks, and is in use for most of the mill and much of the machine gearing running in this country, being the favorite with many engineers and machinists. Fig. 3 shows its shape, the flanks, or parts of the tooth inside of the pitch line, being straight and radial, while the faces, outside of the pitch line, are curved to mate with the straight flanks of the other gear of the pair, the gear flanks with which they are to work.

The tooth has no name, but is known as the "planeflankedepicycloid," which we take the liberty to abbreviate to "plan-oid," retaining the ends only.

In practice it is usually finished, when finished at all, on a gear planer, a machine that guides a single planing tool to follow a template that has been shaped as nearly as may be, and not always very nearly, to the required form. It can also be approximately cut by a common gear-cutting machine, two cuts being made with a slotting cutter to shape the plane flanks, and then two more cuts with a cutter that is curved to the tooth face at its center. Unless the workman has just the right cutter or template, and knows how to set and handle it, the result can be improved with a file.

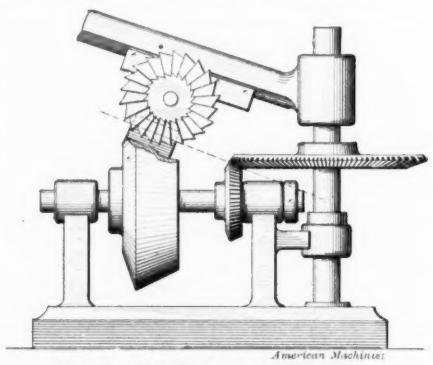


Fig. 2. Simple form of Planoider

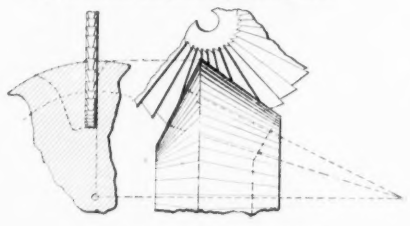


Fig. 4 Slotting the Flank

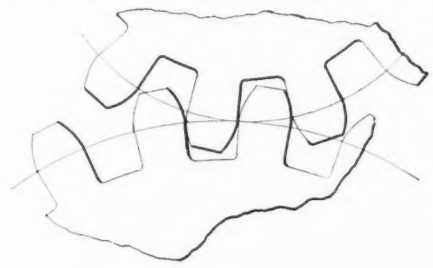


Fig. 3 Planoid Teeth

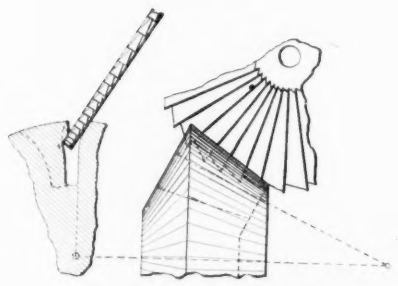


Fig. 5 Sweeping the Face

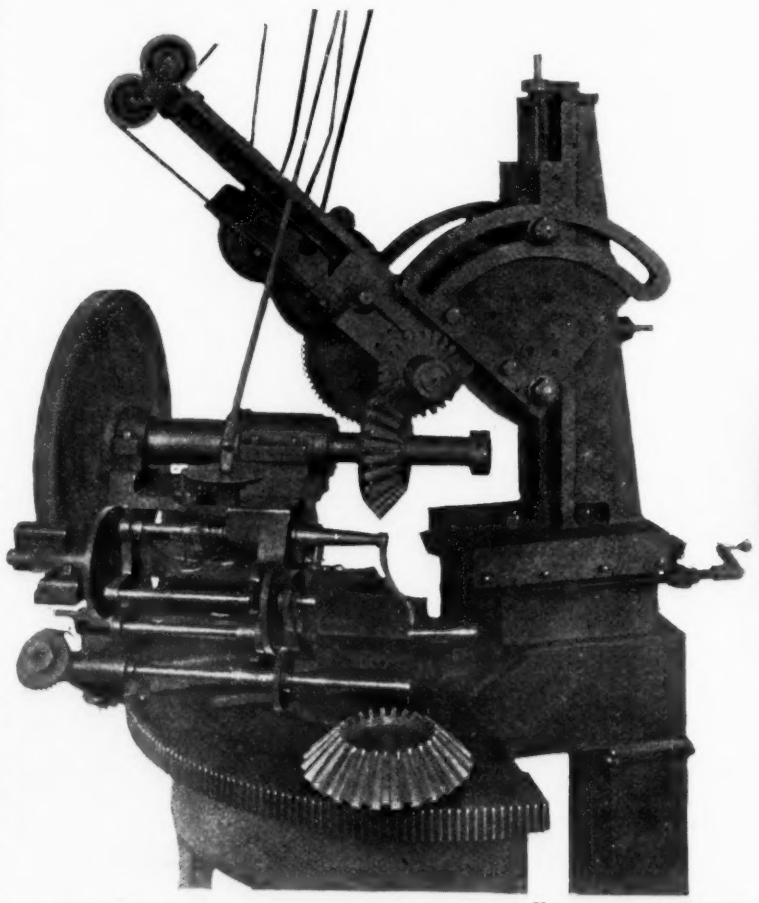


Fig. 6.

EPICYCLOIDAL BEVEL GEAR GENERATOR.

The word "generated," as applied to gear teeth, should be distinguished from the word "cut," as it means to form by virtue of the principle of operation of the machine, rather than to form a copy of a previously formed template or cutter. The common gear cutting machine uses a formed cutter, and makes a copy of it, and the common gear planer makes a copy of a template, but this machine has no definite guide, such as a formed cutter or a template, and sweeps up the true curved tooth surface by means of a flat cutter handled in a peculiar manner. The form of the tooth is due, not only to the form of the cutter used, the same flat cutter being used for all sizes and shapes of teeth, but also to the peculiar motion of the cutter with respect to the gear blank.

The term "theoretical perfection" also needs explanation, as it might be understood as a claim to a perfect product, an acknowledged impossibility. The surface of the bevel gear tooth face is always of varying curvature, being flatter at the back of the tooth than at the point, while the common rotary cutter is always and necessarily of fixed curvature, and, therefore, the surface formed by the cutter must be an approximation at the very best. This machine, however, having no formed cutter, does not approximate, but makes the true tooth surface of varying curvature. If the ordinary gear-cutting machine was perfectly made and perfectly handled it would produce an imperfect tooth, while the planoider, under the same imaginary conditions, would produce perfection, and in practice will approach as near perfection as the skill of the men who make and handle it will permit. By "theoretically perfect" we refer to the process, the theoretical and objective, not the actual result, and, although the machine at present in use is hardly more perfect than a working model, it will reach an actual result that is far ahead of the most perfect result of the ordinary method.

Fig. 2 shows the simplest form of the planoider, or machine for generating this planoid tooth. The vertical shaft carries a guiding arm set at an angle, and the horizontal shaft carries the gear blank to be cut. The flat milling cutter, cutting on its edge and on both sides, is on a carriage that is movable on the arm, and the plane of one of its side cutting surfaces passes through the point of intersection of the two shafts, which point is also the apex of the pitch cone of the gear blank. The two shafts are geared to revolve together, to feed the cutter to its work.

The first operation is to cut out the flank of the tooth in the manner indicated by Fig. 4, the cutter cutting a straight slot with its edge. The second operation is to set the cutter in the middle of the slot thus formed, and to then revolve both shafts and cause it to sweep up a curved planoid surface on the tooth, in the manner indicated by Fig. 5. It will be seen that the cutter will sweep or wipe up a curved surface that will mate with the flat flank of the mating gear, of which flank the flat cutting side of the cutter is the representative. This operation of sweeping up the face of the tooth is in no way a planing operation, as the cutter is drawn sideways across the metal to be removed, and takes but one broad continuous rolling cut to finish the whole surface. As it is impossible to sweep a concave surface with a plane cutting surface, it is plain that this process cannot be applied to any other form of epicycloidal tooth.

The engraving shows the planoider with its cutter just finishing its sweeping cut on the tooth of a ten-inch miter gear, and it is a photograph of the machine itself. The construction of the machine is not the same as that of the simple machine of Fig. 2, for that would not satisfy practical requirements or allow of adjustability, but the resultant motion is the same. The shaft carrying the gear being cut turns on its own axis and also about an imaginary vertical axis, while the cutter is fixed as regards the vertical axis.

Fig. 6 is a photograph of a pair of planoid miter gears, and shows a cutter in working position.

One great advantage of the epicycloidal or planoid form of tooth for bevel gearing with generated teeth, is that it does not require the blanks to be shaped for it alone, but can be cut on blanks shaped by the ordinary rule in use everywhere for the ordinary form of tooth. When the true involute tooth is generated, the natural defect of "interference" requires the blanks to have particular shapes and angles to avoid it and secure a whole and useful tooth. For example, a miter gear of the involute form of tooth cannot have less than thirty teeth if the standard obliquity and addendum is to be retained, and there is no way to avoid the defect except to adopt an angle that makes the tooth stunted, or an addendum that shortens the arc of action. When the gears are of unequal sizes, interference can be avoided by giving the smaller gear a greater addendum than the larger gear, thus throwing the action mostly on the approach side when the larger gear drives. The planoid tooth cannot interfere, and the usual long tooth, with ample arc of action, can be obtained without altering the rule in common use for shaping bevel gear blanks. When bevel gear teeth are shaped with a rotary cutter in the usual way, a very much better result can be obtained by making a short tooth, and sometimes the expense of special cutters can be saved in that way, at the expense of the arc of action.

The planoid tooth is also much more direct in its action, producing much less lateral thrust on the shaft bearings than the involute tooth, and many consider that a great advantage.

Another great advantage of the planoid tooth over any other possible form, an advantage that counts in the cost of cutting the teeth, is that the plane flanks can be cut out on any common milling machine or gear cutter, and the faces afterwards finished on a special machine, thus leaving much the smaller part of the work for the special machine to do. Machinists who have the common tools required to slot out the flanks of their gear teeth can do that part of the work themselves, and be dependent on the planoider only for the finishing of the faces.

Planoid teeth may be roughly cast out in advance, and afterwards finished on the planoider, thus saving much metal and labor.

The principle is not confined to the ordinary small sizes of teeth, for which this first machine was made, but is particularly well adapted to very large teeth, and the machine, it is believed, will be more economical than the gear planer on the largest class of mill gearing.

When a bevel gear has its teeth generated the question of pitch is of small consequence, for there is no formed cutter to be considered and fitted to, and the machine will cut a fractional or an odd pitch as well as one of the regular pitches.

The milling tool has one great advantage over the planing tool, in that it does not tend to break out the edges of the metal where the tool leaves the work. This machine leaves the edges of the teeth quite as whole and sharp as does the common gear-cutting machine.

But one working machine has at this date been made, and that one has proved the practicability of the method. It is simple in construction, easy to manipulate, and economical in use.

The inventor of this system and the manufacturer of the machine is George B. Grant, of Lexington, Mass.

A subscriber in Melbourne, Australia, writes us that "the new and amazing discoveries of gold, not only in West Australia, but under our noses in Victoria, must very shortly give an impetus to machinery business especially."

Direct and Indirect Piping to Indicator.

BY EDWARD J. WILLIS.

It has been suggested in this paper that I make further experiments in the line of long and short indicator connectors. As my former tests were made at over 300 revolutions, I selected for the tests given below an engine (13″x18″) with an adjustable cut off, and running from 90 to 130 revolutions per minute. The same method and apparatus was used as described in my article in the issue of November 23, 1893, and in every respect the same care as to details was exercised, such as pneumatic application of pencils, exchange of indicators, testing of springs both before and after use, etc. The following figures are with an indirect connection composed of 4 feet of ½-inch pipe, four elbows and one ½ inch valve.

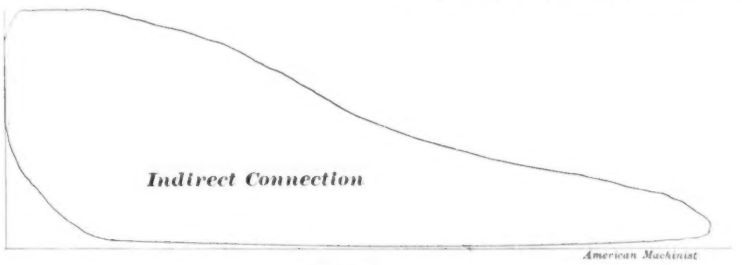


Fig. 1

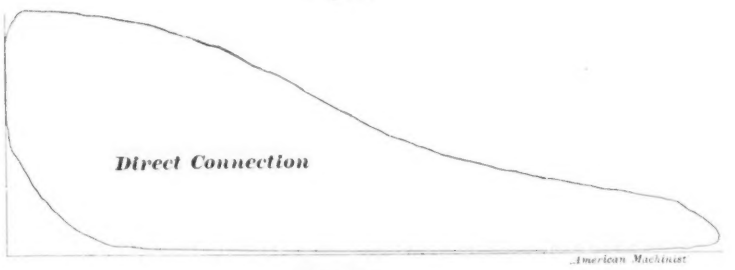


Fig. 1a

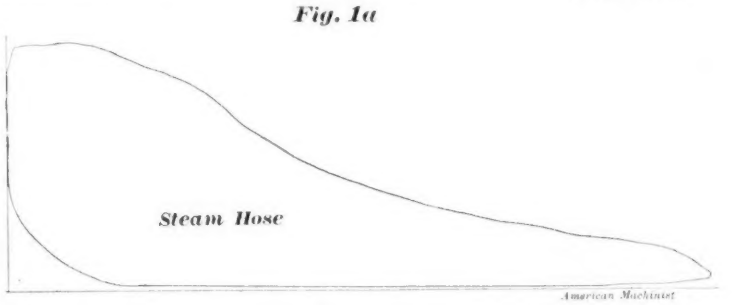


Fig. 2

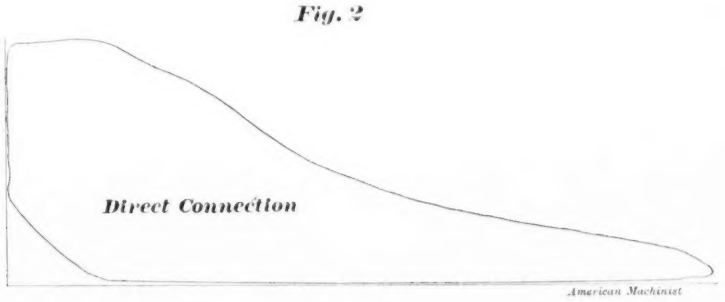


Fig. 2a

Boiler Pressure.	Revolutions.	Spring.	Cut-off.	Mean Effective Pressure.		Horse-power.		Indicators Used
				Direct Connection.	Indirect Connection.	Direct Connection.	Indirect Connection.	
64	105	50	¼	28.79	28.91	36.3	36.4	7 and 5
70	110	50	¼	33.10	33.10	43.1	43.1	7 and 5
75	115	50	¼	34.23	34.40	46.2	46.5	5 and 7
75	115	50	¼	36.28	36.28	49.0	49.0	5 and 7
75	92	50	¼	29.80	30.09	38.1	38.4	7 and 5
75	95	50	¼	29.74	30.09	31.2	34.6	7 and 5
75	90	50	¼	26.19	26.14	28.5	28.5	5 and 7
75	90	50	¼	29.26	28.91	31.9	31.5	5 and 7
Averages.				30.92	30.99	37.8	37.9	....

A further test was made on the same engine with an indirect connection of three ½-inch nipples, one ½ inch elbow and 6 feet of ½ inch steam hose. The hose was coiled up with no attempt to prevent condensation other than blowing it out well before attaching the indicator at the commencement of the test. The results were as follows:

Boiler Pressure.	Revolutions.	Spring.	Cut off.	Mean Effective Pressure.		Horse-power.		Indicators Used
				Direct Connection.	Steam Hose.	Direct Connection.	Steam Hose.	
75	120	50	½	33.65	33.65	49.2	49.2	5 and 7
75	120	50	½	35.70	35.81	52.0	52.3	5 and 7
75	104	50	⅜	30.33	30.27	38.2	38.1	7 and 5
75	104	50	⅜	30.38	30.27	38.3	38.1	7 and 5
75	104	50	⅜	29.56	29.62	37.2	37.3	5 and 7
Averages.		.....	.....	31.92	31.92	43	43	.....

I inclose all the original cards of these tests as well as a tracing of each direct card so that you may see in every case the cards by both connections are practically identical. [We show four of these cards herewith.—ED.]

A forked hose with a three-way cock at the *Y* would seem a very convenient way of attaching an indicator to an engine since the indicator could be clamped in any suitable position for receiving the cord. I have found, however, that the ordinary steam hose is softened by exposure to steam and a sticky black gum is carried to the piston of the indicator.

The last test given above was stopped because I was called off, and on returning after a time found the pipe had so softened inside as to prevent the continuance of the test.

Some think fit to dismiss the matter of long and short connections by the statement that the short is always right, and therefore, why use the long?

While no one would suggest the use of a long connection in preference to a short one when both give a good position for the indicator, it is not always possible to use short connections. In other cases it is very inconvenient to do so, and in still others the excessively long or tortuous cords involve more error than the long pipe connection. It is easy to find by reference to text books the effect on the diagram of high speed, bad cord movement, etc., but I fail to find any positive statements as to the effect of long-pipe connections.

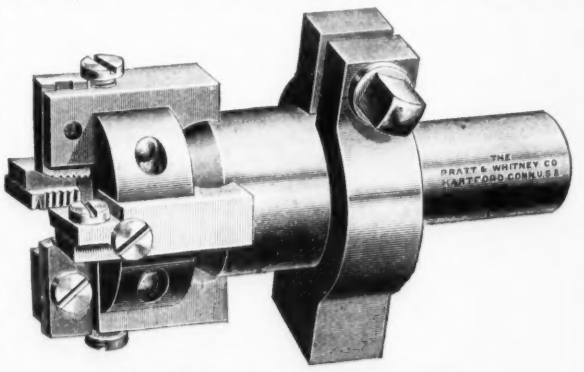
All authorities agree that they should be avoided, but give no example or information as to their effect on the card. The reason of this is that while various and sometimes contradictory faults are ascribed to long connections the general prejudice against them has prevented their having been used so long as to have produced any positive and observable effect on the diagram. In my experiments I have endeavored to use as indirect connections as I could well put in, and, if the cord movement be correct and the instruments in good adjustment, I have never failed to get practically identical results from both long and short connections. It is impossible to prove a law by citing a limited number of examples, but it would be very easy to disprove if some one would make a properly-conducted test, with the effect of the long connection plainly shown. I notice some communications cite instances where different results were obtained from an engine after the removal of a long connection. I have shown in my article in issue of August 31, 1893, how difficult it is with duplicate indicators, directly connected to the same end of the cylinder, to obtain identical results, and then too with an arrangement for applying the pencils simultaneously. One could hardly expect a duplicate card, with a probably changing load, after the time necessary to change the connections; further, the change of the position of the indicator involves a different cord arrangement, which also could alter the result. While I respectfully refer to anything from so eminent a hand as Mr. Porter's, I must say that in his communication in your issue of the 26th of April, he ascribes to the long connection a fault (namely, a tardy admission line) which, in the most atrocious of my pipings, I have never found associated with a long pipe. This fault is the most striking characteristic of a sticking piston.

Tucker's Open Die for Screw Machines.

We illustrate herewith a die designed for use in turret screw machines, and which is so made that when the thread has been cut the die opens, and can be run back without reversing the machine.

The head, body and shank are of one piece of steel. The taper wedge bushing sliding upon the body of the die in one direction, tilts the chaser holders to close the chasers for use, and when pushed in the opposite direction allows them to open. The chaser holders rock in the head on pins, their inner ends being pressed tightly on the sliding wedge by spiral springs. A collar clamped to the sliding wedge serves to open the chasers when it is brought in contact with a stop on the cut-off rest or equivalent part of the machine in which the die is used; it closes the chasers when brought in contact with the cam upon the turret slide as the turret is revolved. The same die can be used for threading different diameters and pitches within a suitable range by substituting one set of chasers for another. In cutting long threads considerable time can be saved by using this die rather than a solid one, for the time of reverse movement of the die is saved, and a better thread is cut than when there is liability of taking a chip in running back.

This die is made in eight sizes for screws from $\frac{1}{16}$ inch to 1½ inches diameter, by The Pratt & Whitney Co., Hartford, Conn.



OPEN DIE FOR SCREW MACHINES.

Distress in Australia.

A Melbourne dispatch says: Australia is anticipating trying times of depression and distress again during the winter which will soon close in. The colonies have by no means recovered entirely from the disastrous slump of two years ago, which depressed every industry and paralyzed almost all the national and individual resources.

"The fear that the distress in the coming winter will be keen is general in men's minds," says the Melbourne *Argus*. After looking over the situation in this colony, the *Argus* takes anything but a hopeful view, though it tries to be cheerful in urging the people able to lend a hand in preparations for relieving the distress that seems inevitable.

Social and business organizations in this city and all over the colony have begun preparations for doing a share in the relief work. Schemes for concerts, lectures, charity fairs, and like devices for raising money are already well under way. The city and colonial governments will reopen the relief works that were organized last winter. One means of helping the unemployed which was very successful last winter was to set them at work clearing the public lands which were soon to be thrown open to settlement. The settlers were required to reimburse the Government for the improvements. Another scheme adopted was to send unemployed men to the old gold diggings, where, under the guidance of old miners, they were able to get out enough gold to afford a fair living for themselves and families. Both these plans are to be worked again this winter if circumstances demand.

The Australian winter is not nearly so severe as the winters in England and the Northern States of America. But people can't eat sunshine, and the prospect is that there will be very many hungry people in the colonies during the dull season which will begin in a month or six weeks. This season may last until the end of August.

It is better to do one thing well than a hundred things indifferently; but, if that system were logically carried out, we would all be machines—not men.—*Puck.*

Compound Marine Engine.

In the accompanying illustration Fig. 1 shows a compound marine engine, in which the pistons travel in opposite directions, the cranks being set at 180 degrees. The principal novelty in the design is the piston valve, which admits steam to the high-pressure cylinder, then exhausts it into the low-pressure cylinder, and finally into the atmosphere or condenser. The distribution of the steam by the means of this valve is clearly indicated in Fig. 2, which shows a sectional elevation, a sectional plan, and a plan of the cylinders and valve. This figure also serves to show the compactness with which the cylinders and valve may be arranged, the valve being operated by a radial valve gear.

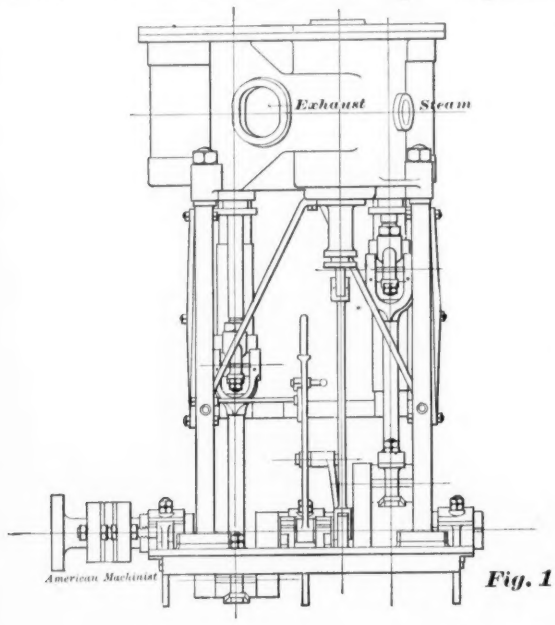
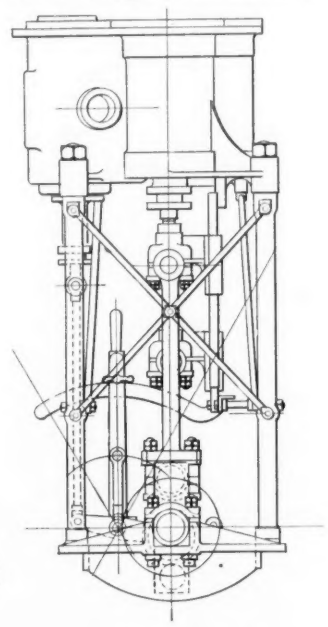


Fig. 1



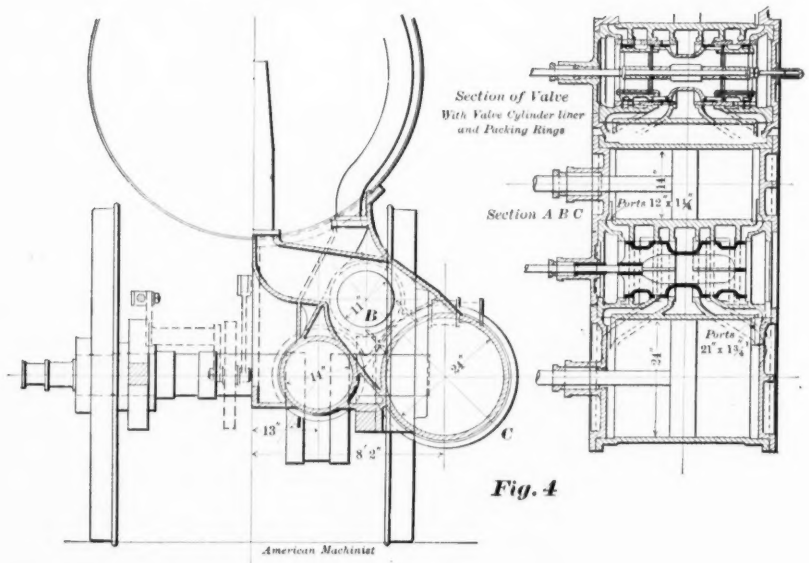


Fig. 4

A quadruple expansion engine can be arranged on this principle, one set of cranks being placed at 90 degrees with the other set, as shown in Fig. 3, thereby securing a nearly perfect balance of working parts with great uniformity of motion, and comparative simplicity.

Mr. Charles Ward, the inventor of the well-known water-tube boiler, put a small engine of the type shown in Fig. 1 into the steam launch "Mascot," lately built by him for the War Department Engineer Corps.

The hull, which is made of steel, is 61 feet long, 8 feet 1 inch beam, 3 feet 4 inches deep, drawing 7 inches forward and 14 inches aft. The engine has cylinders 6½ and 13 inches in diameter, 8 inches stroke. During the trial the engine ran at the rate of 540 revolutions per minute, driving the boat 13¼ miles per hour. The engine worked power was judged to be from 70 to 75, or one horse-power for every 27 to 30 pounds weight of machinery.

The accompanying designs were made by the inventor of the valve, John Haug, Mechanical Engineer and Marine Architect, 206 Walnut place, Philadelphia, Pa.

Fig. 4 shows the application of this system of cylinders and valve to a compound locomotive, as proposed by Mr. Haug. The cranks on each side of the locomotive are set opposite to each other, and one set of cranks placed at 90 degrees to the other. One valve and gear for each set of cylinders will suffice, thereby maintaining comparative simplicity. With this arrangement the moving parts will be better balanced than in the ordinary engine, and consequently the hammering on the rails reduced.

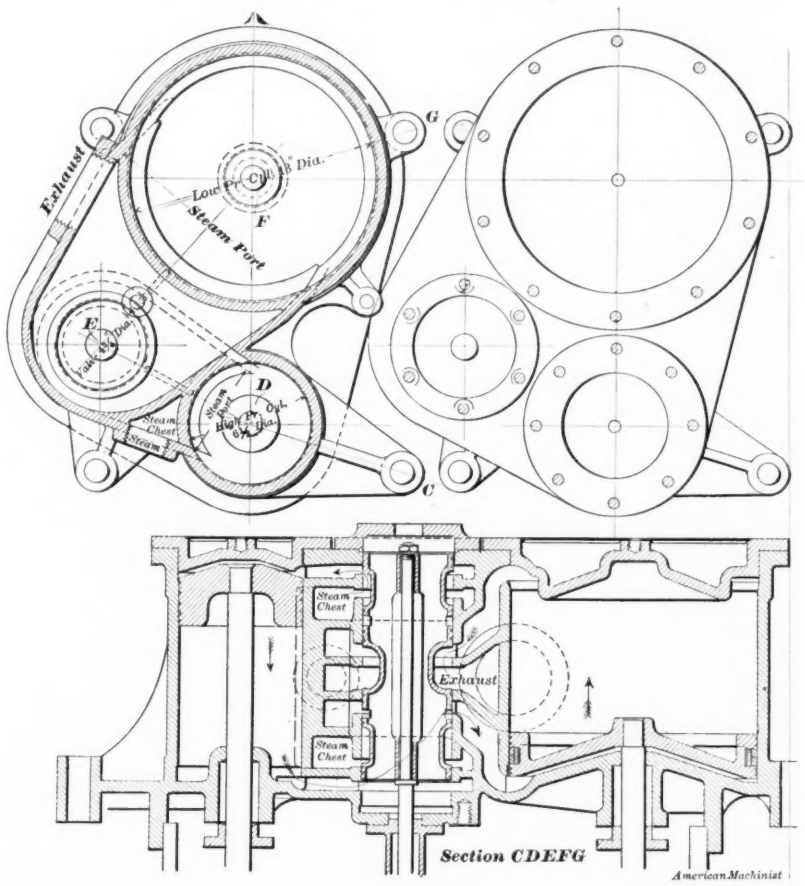


Fig. 2

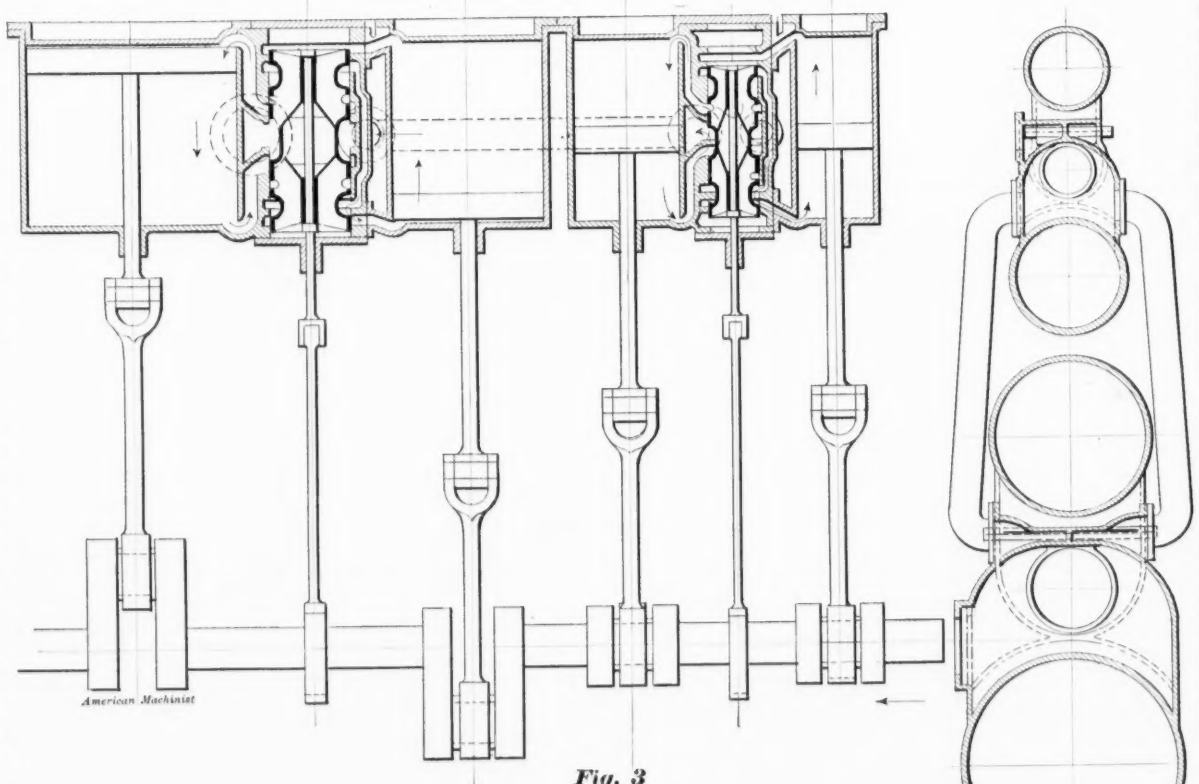


Fig. 3

Exorbitant Claims.

BY W. H. WAKEMAN.

It is all right for a man to be enthusiastic over some or all of his inventions or improvements, and to claim that they will do everything that his conscience will allow him to, but at the same time I think that it is quite possible to carry it too far, and thus do his cause more injury than any of his enemies could for him.

If a man invents or purchases a boiler cleaner it is proper for him to claim that it will keep boilers clean, and even for him to say that it will remove old scale, prevent explosions, save fuel, etc., and if he has an article on hand that will do these things, he will not need to look very far for purchasers, and there is no necessity for him to make unreasonable claims; but when he says that if a corporation or firm purchases one of his machines, inspection and insurance of the boilers will be no longer necessary, probably he has mistaken his calling. By what system of reasoning can a person demonstrate that any device that can be attached to a boiler will obviate the necessity of careful inspection? If a plate is beginning to blister, will the apparatus report it? If a brace or stay-bolt fails, will the machine tell us of it? If internal grooving is getting in its work, shall we be informed of it by this boiler cleaner? If external corrosion is eating its way into the plates, will due warning be given us by this device? I think not.

Again, suppose that a man brings out a new kind of engine, or produces plans for factories and mills which are very good, so that no one can point out serious defects in them, is it reasonable or sensible or honest for him to claim that by the adoption of his device or plans the necessity of hiring an engineer to run the plant will be dispensed with? We have not yet discovered it, and yet we find men who claim to know something of the business, telling us that if their advice is followed in purchasing the machinery and erecting it, some of the operatives in the mill can easily give the engine all the attention that it needs without interfering with their regular duties. If such cranks had only well-informed men to deal with, the case would be different, but unfortunately some steam users will pay more attention to assertions made by some such party than they will to those made by men who understand the business much more thoroughly, because they have had more experience and given the mat-

ter much more attention. The reason for this is not hard to find, for it is only natural for manufacturers to wish to run their plants as economically as possible, and while this is perfectly proper within certain limits, still there are always those who care but little whether their engines and boilers are well taken care of or not, so long as the wheels revolve 10 hours per day and the boilers do not go up in a cloud of dust. These men will not listen to their engineers. On the other hand, there are some proprietors that take much pride in having a fine looking plant, and would not retain an engineer in their employ who failed to keep it clean and in good repair. Such men place much confidence in the statements of their engineers, and but little in those made by men whose principal object is to get a large price for a small article.

LETTERS FROM PRACTICAL MEN.

"Three or Four Cutters in Die Heads."

Editor American Machinist:

I have read the article in issue of March 1st, under the title given above, and in accordance with your request, will attempt to give something of our experience in the matter. Although we have not much to offer, we feel obliged to take exception to some of the remarks of our English friend. For instance, he says:

"We are well aware of the opinion held in the United States as to the three or four-die machine, but we are equally convinced from a very wide experience that it is an utterly fallacious one, in fact, the experience in this country of all engineers with both three and four-die machines is so decisive that no one would accept a four-die machine, except in the case of thin tubes where it is necessary not to put too much work on any die, and so distort the tubes."

It seems to me that he fully explains the whole matter when he refers to the thin tube. If the four dies did not do the work better than three, they would not cut the thin tube, and it is certainly the practice to have from four to ten cutters on a pipe machine for threading steam and gas pipe. For threading 8-inch pipes ten dies are used; for 6-inch, eight dies, etc.

Further on he says:

"Whether the climate has anything to do with it or not, we do not know, but certainly in this country the four die machine has been tested and discarded years ago, and we are quite convinced that the boasted advantages of the four die machine do not really exist."

As to this matter of the possible effect of climate on the good or bad working of four-die machines, perhaps the best evidence I can offer to show that the good working of the latter does not depend upon United States climatic influences, is found in the fact that we have shipped a great many four-die machines abroad, and they have worked well there. They even work well in the climate of England, as is shown by the fact that about thirty-five machines are, and have been for some time, doing so at the works of Messrs. Hutchinson, Hollingworth & Co., of Dobcross, near Oldham, England. The threading machines furnished them were all four-die machines, some solid and others open die, which, of course, are the same, so far as character of cut is concerned. These machines took the place of the three die machines which they had in their works, and were sent to them in five shipments—May 3, 1889; April 9, 1890; August 12, 1890; May 19, 1892 and July 28, 1892.

We have recently shipped a two-spindle machine to I. I. Tillmanns, New Cronenberg, Germany. We also sent one of our threading heads to Dawson, Taylor & Co., Limited, Manchester, England. They built the machine and applied the head from sketch furnished them. This particular machine was gotten up specially for threading the Grinnell sprinkler heads. (Our heads were first introduced into the works of the General Fire Extinguisher Co., of Providence, R. I., for this purpose.) I forward you a photograph received from the above named parties, showing the head in position. The machine proper you will see was built by the Atlas Engineering Co., of Manchester, England.

The three-die machines have been thoroughly tried in this country, and for a number of years the Schlenker automatic revolving die bolt cutter was made with three cutters. Though adopted and used for a time by some of our leading bolt manufacturers, it did not stand the test, and is now made with four cutters, no doubt with adequate reasons mechanical and commercial.

The question of three or four dies for bolt cutters may be likened to three or four-legged stools. A three-legged stool will adapt itself to any floor and stand upon it firmly, even though the stool is thrown considerably out from the perpendicular, but with four legs the floor must be even, and the stool will then stand firmly at right angles to it.

I believe the practice is quite general in making dies to drill and tap and muzzle out the front of the die with a tool and then file the cutting edge or lip of the die to the circle described by the tool, which, in my judgment, is not good practice. My experience has been that, in order to make a

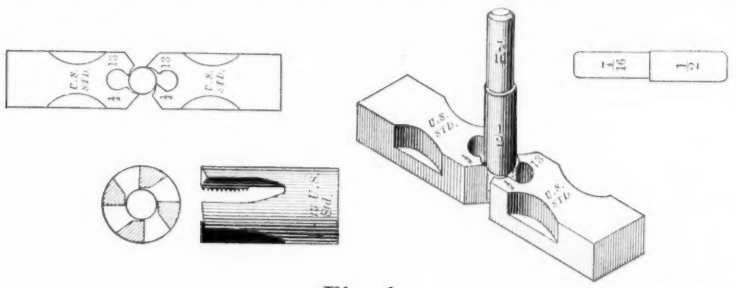


Fig. 1.

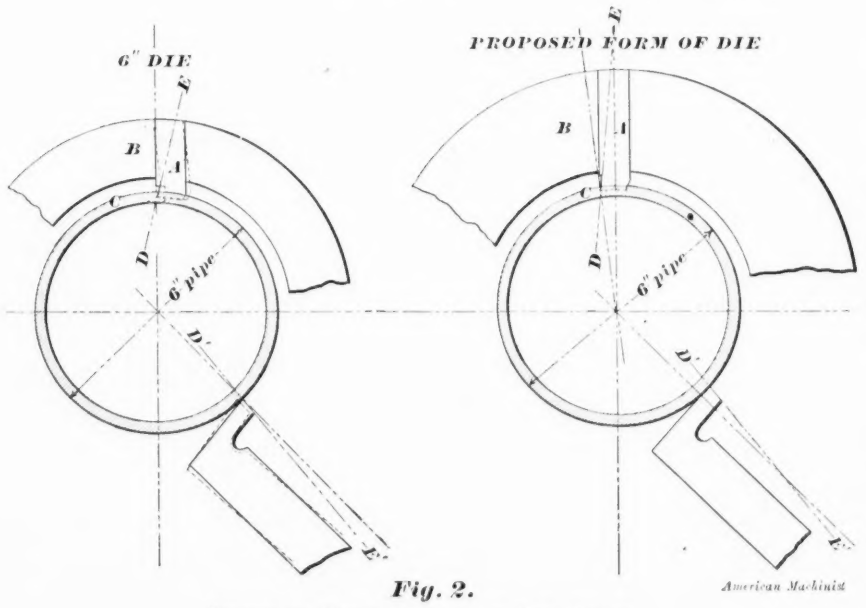


Fig. 2.

THREE OR FOUR CUTTERS IN DIE HEADS.

die cut well and do good work each cutting edge must do its proportional part, and one cutting edge must not be longer than the other. To accomplish this we use a plug which is represented on the blue print which we send you, Fig. 1. After the dies are filed up they are put together in a jig, in which they are drilled and tapped and the plug set into the muzzle of the die, and if each cutting edge touches the plug the die is considered right. If it does not it is made to do so. For instance, the dies are filed exactly right and then hardened. In hardening one of the dies springs or both of them may spring. I claim that with a three-die machine it is impossible, without special and elaborate fixtures, to ascertain whether or not the dies are right, but with the four cutting edges it can be at once ascertained by putting the dies together, as shown on blue print, and testing by the plug.

It is very easy to make a statement, but the next thing is to prove it, and for that reason I send you, under separate cover, pieces of pure copper which we have threaded. One is ⅜ inch diameter, cut four square threads to the inch; one ½ inch diameter, cut 5 threads to the inch, coach screw thread; one ⅝ inch diameter, cut four threads to the inch, coach screw thread; one ⅝ inch diameter, square thread, also same diameter with skein thread, square, three and one half to the inch; one ¾ inch diameter double thread, three to the inch. These pieces were threaded with dies that had been running on steel and iron, the ⅝ inch square thread four to the inch for cutting screws for apple parers; and when you take into consideration what an apple parer retails for, it will give you some idea of how cheaply we have to thread them. Understand, these pieces of stock were threaded after the dies had been running on steel without any change whatever, using our regular mixture of oil. If any one in this country or any other will produce a three-die machine or head that will cut square threads, four to the inch on a bar of pure copper, ⅜ inch diameter, without twisting the copper, he will at once convince me that the three-die head is as good as the four die, and not until then. These pieces after cutting were simply cleaned, which gives them the bright appearance; they were dipped in a preparation to clean them.

We also send you a blue print (Fig. 2) taken from a drawing which we have used in working up and explaining the advantages and disadvantages in the different forms of dies, and the placing of the cutting edge in relation to the center. We claim that the cutting edge of the die should be set ahead of the center exactly as the turning tool should be set above the center on a turning lathe.

In this blue print *A* is the chaser; *B* is the die frame, with slot to receive the chaser; *C* is a piece of 6 inch pipe. Line *D E* represents the cutting edge of chaser. If this angle is varied a more or less shearing cut is the result. Steel pipe requires a more shearing cut than iron pipe. Line *D E'* represents the cutting edge of a lathe tool on an angle representing the cutting edge of a chaser.

If the cutting edge when the die is new is brought exactly to the center, the first time the dies are ground it is back of the center, and in our experience will not work well. Our practice is to set the die as much ahead of the center as it can be, and do the work; then as we begin to grind the die it will improve for the first two or three grindings, then it goes the other way until we have ground down to the center line. When we get there it is certainly time to stop and replace with a new die.

We also send you in the same package with the copper pieces some sample pieces cut from very inferior rolled stock (low grade steel) which will show you exactly how the dies work. We have stopped the machine when it was cutting and opened the dies, taking the pieces out, leaving the curled chips attached to the pieces in their respective places. Some of them have been broken off—as it is practically impossible to handle them without breaking them off—but there will be enough left to show you the working of the die and that each and every tooth does its respective part of the work, which has to be for a die to work well and obtain good work.

GEORGE H. WEBB,
Agent and Supt. Pawtucket Mfg. Co.
Pawtucket, R. I.

[It would not be practicable to show by engravings of the specimens referred to by Mr. Webb anything which will not be as well understood by his description of them. They certainly show a remarkably free cutting action of the threading dies, that each of the four cutting edges takes an equal chip and that the metal is *cut away*, not pushed or jammed off as is undoubtedly too often the case with dies.—ED.]

High Terminal Pressure or Low Initial Pressure in Locomotive Cylinders.

Editor American Machinist:

Mr. Harris Tabor, in a communication which recently appeared in the AMERICAN MACHINIST, makes the following statement: "It is well known that steam cannot be expanded in locomotive cylinders to the extent that is called for in stationary engines, for the exhaust would not be sufficient to give the required draught." This may be one reason why locomotives are not equipped with three and four sets of cylinders, a condenser, air pump, etc., but if so, it is one of such infinitesimal importance that no one has ever before given it recognition, much less stamped it as a well-known fact. If Mr. Tabor had seen his statement in cold type before the paper was issued he would probably have run his pencil through it.—*Railway Review.*

The above quotation suggests that the wrong interpretation may have been given to the expression "well known." There is no knowledge so general that it reaches all, and therefore any bare statement of fact must usually be addressed solely to those familiar with that particular subject. In making the above statement the writer did it with a full understanding that it might come within the reach of an occasional reader whose line of investigation was in other directions. It is not surprising if a clergyman or merchant would understand it less than a Bible quotation or a yard stick, or that an occasional editor, whose experience in such matters is limited, should take exceptions to it. None the less it is well known to all who deal with the problem of burning coal on a locomotive grate, and no class of men understand this better than the heads of railway motive departments, whose duties are in the line of burning coal, and pulling trains thereby.

The average indicator card from locomotive cylinders will show a back pressure equal to or greater than the terminal pressure in the average non-condensing "Corliss" engine, and a terminal pressure quite as high as the mean effective pressure in the average high-grade stationary engine. The terminal pressure is the measure of cylinder expansion, and in all engines, such as locomotives and farm tractions, where abnormally high terminal and back pressures are needed to give strong draught, steam expansion is limited, and this limit may come outside the best coal duty.

A few years ago a friend of the writer designed a spark arrester for locomotives and farm tractions which called for a slightly reduced draught pressure. A test was made on a locomotive used for helping freight trains over a grade about 10 miles long. In nearly all cases the usual conditions were followed, and the start, at the foot of grade, was made with a boiler pressure of about 130 pounds, and the link in position to cut-off at about ¼ stroke. Before the push was half completed the boiler pressure would fall 30 or 40 pounds, and it was necessary to change the position of link to give a cut off of ⅜ stroke, or later,

to get sufficient draught to restore boiler pressure to running conditions. Here was a case where the boiler was deficient when the engines were working at their best, in the way of steam consumption, and all on account of lack of draught pressure. The later cut-off reduced expansion and gave higher terminal and exhaust pressures which increased the draught to such an extent that the additional steam required by the cylinders was not only supplied, but the boiler pressure was quickly restored.

It is pretty generally "well known" among locomotive runners that there are certain notches in their quadrants which are rarely used, and solely for the reason that their fire would soon die down from insufficient draught, and yet these notches would give less expansion than is common in the average "Corliss" engine.

The appearance of that sentence in "cold" type has not encouraged a disposition to run a pencil through it, but it does make one feel like putting it in italics.

HARRIS TABOR.

The Mechanical Value of War.

Editor American Machinist:

"Bell Crank" has fallen foul of Mr. Forbes over the above question. I am glad to see he has done so. There is a section of every community who are never satisfied unless they are glorifying war. It is perfectly true that implements of warfare are called for of the highest quality and finish, but this is simply because the grasping and greedy military element are never satisfied unless they are calling for some further means of destruction, and when matters appear peaceable of raising up scares so as to show a reason for their own useless existence. What are the true facts?

Take my own case as the example with which I am best acquainted. About two thirds of my yearly imperial taxation goes to war purposes and interest on old war debts. About half of my municipal taxation goes to support those who have come to want as a result of the weight of the imperial form of taxation.

Were I relieved of the entirely unnecessary portion of my taxation I should find myself with more money to spend at the year's end; I might spend that money in watches or in a high-class microscope. The increased call for these two articles of fine workmanship which would be created by a reduction of taxation would give a far greater impetus to the machinist's art than that given by the present direction of the expenditure. Having secured what I want of the above articles I should still find another year's taxation money on my hands, and this I should spend probably on a trip to America. This, with the many other sums similarly expended, would go to produce a four-day steamer, the mechanical work on which would do far more to forward naval architecture than the present mischievous demands of the fighting men, so many of whom are apt to send in their papers when really grave symptoms arise to give them cause to fear the results they have professed to desire, to wit, a chance to fight.

So I might go on and show how I should influence the manufacture of high-class locomotives or of typewriters in combination with other eight million or so men in these islands alone, all of whom by their increased expenditure on useful articles or travel would assist to develop true industry to such an extent that the whole of the present fighting forces would be more than absorbed in the demand for help.

The cry of the Jingo or Chauvinist is always that if war expenditure were stopped there would be so many men out of employment. Was ever a more lunatic idea promulgated? Equally good reasoning would it be to urge the burning of good buildings to find employment for masons.

If taxation takes away part of my income I am perfectly correct in saying, without entering into an explanation of the details, that I cannot have a new greenhouse stove because the iron for making it has been taken to make an 80 ton gun, or that the wool for a new carpet has been taken for powder bags.

The mechanical arts have been utilized in preparing munitions of war, but it is extremely doubtful if these have really done anything to advance the art of the machinist that could compare with what would have been effected by the expenditure of the money and energy in peaceful lines.

It cannot be claimed that the pursuit of war has been productive of the exhibition of any special intelligence even on the best side. Compare ships of war and the mercantile marine, and note how the merchant vessel will make hundreds of voyages with safety and regularity whilst the vessel of war is in a chronic state of breakdown and disaster simply because the *personnel* of the navy is in a sense protected against external competition and fails even to learn from good example.

The money expended in one year on war purposes by this country would easily make seaports of Birmingham and Sheffield, both of which cities want to have ocean carriage to their doors. London's share of taxation would pay for a new and clean water supply from lakes 300 miles away faster than the works could be carried on.

The Manchester ship canal cost eighty million dollars, and though constructed with all possible speed the annual expenditure was less than the war tax of the circle only 20 miles round Manchester as a center, and so I might continue without limit showing how we could have all these and similar improvements for nothing if only men had sense to abolish their fighting men, beginning with the emperors *et hoc genus omne.*

London. W. H. BOOTH.

Fig. 3.

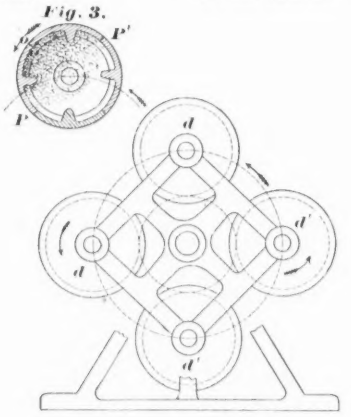


Fig. 1.

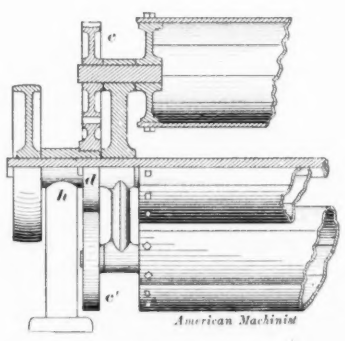


Fig. 2.

DUPLEX RATTLE BOX.

Duplex Rattle Box.

Editor American Machinist:

I once had occasion to design and construct a machine, the like of which I had not seen, nor have I since met with anything like it. It was nothing more nor less than a duplex rattle box, and might be said to be somewhat complex, yet it performed its work admirably. I inclose you a rough sketch of this machine, thinking it may be of interest to some of your many readers. Rattlers, it is well known, are extensively used in many kinds of scouring processes, in forgings, from tacks to turnbuckles, and in castings, from jack stones to journal boxes. The objection to the ordinary rattler in my case, and one I fancy that is often met with, was its restricted motion preventing a sufficiently active movement of the material being scoured, for just at a time when the rattling begins to be effective in such machines, centrifugal force comes into play and everything is quiet. So I concluded to ignore the laws of gravitation and employ the first named force for all it was worth.

A lengthy description of my machine will not be necessary. I used but two cylinders, or boxes, opposite each other. In the cut, Fig. 1, four are shown at a, a', a, a'. The gear wheel d, Fig. 2, is stationary, being fixed to the journal box h. The wheels c, c, gear into this, and by a proper proportion being given these wheels, any desired effect may be secured, dependent on the axial motion of the boxes as they move in their orbit about the central shaft; thus suiting the violence of the action within the boxes to the character of the work being done. It is obvious various shapes may be given to the boxes; those I used were square. When the round form is used, flanges projecting inwardly may be of service, as shown in Fig. 3. These will prevent any sliding of the contents when at a point, as shown at O, effecting a transfer from P to P', at a time when it will be the most effective.

"QUIRK."

Making Drawings for Machinists' Use—Accurate Work.

Editor American Machinist:

Allow me to make a few remarks relative to the above, as I think it necessary to do so. First of all, I have to thank Mr. "A Mechanic" (April 26th) for the compliment involved in the statement with which his communication begins, and I will state here that the sole inspiration with which "Errors on Drawings" has been written was to make matters easy in machine shops between machinists, draftsmen, and all concerned, and if the remarks have had such a tendency, they have fulfilled their mission.

"A Mechanic" states that he differs in opinion relative to measurements of levers, and shows how he would proceed to lay the work out, which, no doubt, has many virtues of its own, yet he has failed to prove *why* it is the most economical method to give the dimensions by means of a triangle. Perhaps I have given no proof that the "improvement," as "A Mechanic" calls it, is the better way, and if this is the case, let me state now that I, at times, have been in the habit of making lever drawings in the manner "A Mechanic" would prefer, but in every case I was compelled to convert those dimensions to such as would conform with rectangular co-ordinates, or, as machinists put it, "to the square line." And I have had to do with many a lever, with more, perhaps, than is custom in general machines, not only as a draftsman, but also as a *poor* machinist. In sketch showing the lever, I had chosen a lever that could easily be swung in a medium-sized lathe, but let us suppose that this lever be one of greater magnitude, such that it possibly could not be swung in a lathe or other tool of similar nature, I think "A Mechanic" then would admit the utility of "improvement."

As to accurate work, I fail to see the lack of accuracy alleged to exist in the "improved" lever drawing. "A Mechanic" shows the proceeding when receiving such a drawing, but is that all that can be done? If I were the proprietor I would object also if somebody would draw a series of lines upon surface plates necessitating a re-truing. But then, is not "A Mechanic's" method of measuring just as, or perhaps still more, arbitrary then somebody else's? He only can, and does, rely upon what he sees, and not upon what he calculates or feels. Many a machinist will, and does, work unknowingly to a greater accuracy than is represented by .001" simply by feeling, and this sense of feeling is so far developed that he says: I feel the difference in hardness of metal (when cutting in any machine, and he actually does feel it). So also does he feel the difference of dimensions in whatsoever way obtained or tested, yet these very men may not understand you when talking about .001". I would also state that I fail to see in what way a variation from the figure 4.334" to 4.333" or 4.335 would create a disturbance of $\frac{1}{64}$", and to the doubt expressed that the machinist would not know *how it was got.*

I think we are justified to say the same thing "A Mechanic" does with reference to that draftsman who wanted to show when and how to drill a piece of steel, namely, he is meddling with some other fellow's business.

As to rules and originality in machine shops, and with horses, I think neither one can do without the other, although I have had nothing to do with horses, yet he is the best mechanic, who not only possesses the largest amount of originality, but also who prudently knows how, and when, to apply somebody else's rules, and the best managed machine shops are not only where the greatest wisdom is used to draw the line as to how far each shall go with his work, but those where, at the same time, each and every one respects the other, for there is then the least friction, which is good neither for the proprietor, machinist nor draftsman, all of whom are working for dollars and cents, and not for glory. With propriety "A Mechanic" has compared drawings with letters, but clearness without any jugglery is essential to both, so that the respective parties know exactly what to do.

E. LAWRENZ.

A Cost-keeping System.

Editor American Machinist:

I note with pleasure in your issue of May 17th "Bell Crank's" friendly criticism of my article on a cost keeping system in your issue of February 8th. His points are certainly well taken and indicate an intimate acquaintance with the subject, while the character of his letter is such as to call forth any further information that can be given.

Although he has to a certain extent solved his own problems in his letter, yet it may not be amiss to take up his various observations in order. The kind of shop which he considers to present the most difficulty, viz., one handling several varieties of regular work, in lots of varying sizes along with special machinery, repairs and jobbing, comes very near to that for which this system was originally designed, and it must be admitted that the solution of all the problems has not been an easy one.

In explanation of two sets of consecutive order numbers—one for production and one for shipping—distinguished only by the prefix letter p in the case of the former—it may be said that at the time of the introduction of this production order system, the shipping numbers were already so far advanced as to require five figures for their expression. Consequently, the convenience of a single prefix letter in preference to a word or words has proved sufficient, whereas had the two systems been put in operation at the same time such a means of distinction might only have resulted in confusion.

"Bell Crank," so far as this principle is concerned, speaks truly when he says that the foreman knowing the most about the work should have charge of the time-keeping thereon. But then the foreman must be capable of it, and of keeping the time cards in systematic shape. Here lies the trouble in many cases, particularly when the system is newly introduced and meets with opposition. Therefore, all things considered, I still hold my opinion as expressed in the article referred to, that perfection can only be secured by the presence of a time-keeper passing constantly among the men—in reality, the equivalent of the clerk to whom "Bell Crank" refers. In fact, such an arrangement substantially meets all the necessities of the system, as pointed out by "Bell Crank."

Thus, if under his first observation several men work on the same piece at different times, accurate individual cards will serve to keep everything straight.

The only way that has presented itself to me for satisfactorily dealing with his second case, where work is suspended on a given piece or pieces, is to indicate same on the time-card and individually tag the incompleted pieces with product order number. This works right in with the system of in-

spector's tags on finished work. It operates successfully in the shop under consideration, but I can readily see that under other conditions the difficulty might be almost insurmountable.

Work expended on defective material has been kept by mere note to that effect upon the time-card. This, in fact, is an important feature with piece-workers, and the special piece-workers' time card has been employed thus: If the piece is good, it goes in with the regular lot and is receipted for by the inspector, but if bad his attention is called to the fact, and if discarded the time card is filled out with time on defective piece. Incidentally, these cards were at one time filed under such headings (in envelopes) as to collect evidence regarding wasted time because of poor molding, chilled pulley rims, and the like.

The question of robbing one or more of a regular lot of machines in process in order to repair another, presents one of the greatest difficulties of any system. Only by vigilance can inaccurate records be avoided. Almost without exception the piece thus taken is fully completed before being sent away, and consequently a memorandum filed in the production order envelope may make definite record of this interference with the regular procedure.

But repairs are always wanted in a hurry, and a man in a hurry is always sure to forget something, so that the utmost care should be taken to prevent omission of this necessary report. In the case of piece-work, it is readily accounted for by the number of pieces receipted for.

After all, the greatest advantage of this system of individual time-cards and filing envelopes would appear to lie in the ease with which such reports and records may be made and kept. With a direct book record, on the other hand, there is more chance of overlooking such an entry and almost always the inconvenience of lack of space for its proper presentation in the book.

It certainly would be of interest to many of your readers to learn if others have had experiences along these lines that would tend to simplify or render more accurate the keeping of time and the calculation of costs.

WALTER B. SNOW.

Foundry Use of Physical and Chemical Tests.*

BY W. J. KEEP, DETROIT.

I began this discussion by saying that the only way to arrive at correct conclusions regarding cast-iron, was by means of properly conducted physical tests explained by chemical analysis; also, that the physical structure of cast-iron is not wholly dependent on its chemical constitution; also, that a determination of shrinkage and chill would indicate when the correct percentage of silicon was present, and that the strength and deflection would tell if the mixture had been arranged to the best advantage.

Some have objected to my methods, rather than defend their own side of the case by facts and figures.

Opposition to New Methods.—There are those who always oppose a new manner of arriving at conclusions. Not one of those who have raised objections, has ever used or seen my apparatus, or has seen one of my half inch test bars. A letter lately received speaks as follows: "The difficulty with the chemists, and with all who have not had practical experience with your admirable system, is that they are disqualified for an intelligent understanding of the question at all." It is easier to object and imagine difficulties, than it is to present results of original research.

My effort has been to find reasons for the behavior of cast-iron, and to present them in such a manner that the founder who has not had the advantage of a chemical education can intelligently purchase and use iron.

The one-half inch Square Test Bar.—The explanation of the influence of the five metaloids in cast-iron, which has been made during the last six years, by a study of the half-inch bar, is all the defense that it needs. I gave a summary of these conclusions in my paper of April 4th.

It has been stated that "test bars to be trustworthy must be of a size to give approximately constant results." The truth is, test bars to be trustworthy must be of a size to show correctly the quality of the iron; and cast-iron always varies.

I only recommend the half-inch test bar for iron that will run gray or nearly so in this size, and this covers nine-tenths of foundry practice. The large amount of surface exposed to the mold makes a uniform grain throughout, and causes it to indicate the slightest change in composition.

General Application of the half inch Test Bar.—The behavior of this bar is the measure of the effect of silicon in a casting, whether large or small, just as a foot rule can measure a large or small object.

In *The Iron Age*, May 17th, p. 946, Mr. E. H. Mumford (with Henry R. Worthington) says: "It may be taken for a fact, that no one size of test bar is better adapted to a certain class of work than another. The great truth in this matter of test bars is, that whatever their shape, size or method of molding, they should always be made and tested in exactly the same way. Follow up Mr. Keep's system, and you will get results like what follows:

"If a water cylinder 3 inches thick and weighing eight tons, gives a bar in 'Keep's Test' that runs 450 in strength, .155 of an inch in shrinkage and .08 of an inch chill, you may be sure that the casting is free from shrinkage strains, will cut easily and is strong. If the same casting gives you a Keep bar that runs 350 in strength, .170 of an inch shrinkage and .25 of an inch chill, you may be sure that you have a casting that, while it looks close and strong, will take twice as long to machine, has put its thinner portions under immense initial stress, and is very likely, therefore, to show shrinkage cracks, as the iron has not the strength necessary to resist either these or its working bursting pressure in service afterward, certainly not both at once. All this the little half inch bar tells you of the big casting, and it does it better than the larger bar would."

I am allowed to take the following from the books of one of our largest machine foundries: "By analysis, silicon 3.26, average chill of a Keep's bar .075, shrinkage .154, strength 436. Iron, open and soft, perhaps our best iron for general work."

3.00 or 3.25 per cent. silicon, and shrinkage .125 will make good stove plate, but a large machine casting must contain less silicon, which will be indicated by higher skrinkage.

Influence of Iron Standing in a Ladle.—I introduced in my last paper nine series of tests to indicate what could be shown by physical tests, and that chemical analysis could not do as much. I did not intend to turn the discussion in another direction. The 3.25 per cent. silicon iron, drawn from a cupola as fast as melted, produced stronger castings from the portion of iron which had been longest in the ladle. To get an explanation of the different experience of some who had observed an opposite effect, the experiment was tried at a prominent machine foundry in this city. The iron was for a 3 ton cylinder, and was very dull. This is shown in Series X (continuing the numbers of my last paper).

I also made a mixture of pig irons and scrap the same as in Series VII. to IX., and melted it in a crucible. This is shown in numbers 803 to 805 of Series XI. I also melted one brand of pig iron in a crucible, as shown in numbers 833 to 836.

Both these and the tests in my paper of April 4th show how iron behaved in each case, and taken together show that under different conditions different results may be obtained.

The Influence of Wet and Dry Molds.—As this question has been raised "Keep's Test" can give the desired information. I have purposely gone to extremes. In 814 the mold was so wet that one bar was perfectly hollow from a blow hole. In the other wet molds the sand was as wet as possible to get sound castings. The dry molds were thoroughly dried. The regular mold was "tempered as for ordinary work, only rather dry" (Pamphlet "Keep's Test for Cast iron," p. 7).

The Influence of Temperature of Cupola.—In the investigation of another subject the tests in Series XIII. were made. Tests 812, 813, 824 and 825 were from the first iron that came down, which boiled on the cupola bottom on account of the moisture which it contained. 812 and 824 were caught in a freshly dried ladle and then changed to another fresh ladle, the iron boiling in both. 813 was caught in a red-hot ladle, next after 812, and shows only the influence of the boiling on the cupola bottom. 825 was caught in the hot ladle after pouring 824, but 300 pounds of iron had been taken out between the catches and the iron had improved. 815 and 826 were from the middle of the heat, and show average iron. Each of the tests in this paper were on different days, and are each averages of from 3 to 5 test bars. (Series IV. in my last paper is the test of the single bar of the set which was analyzed, while Series VII. to IX. show the averages of the three test bars of each set. This explains the difference in the figures.)

The Object in Producing these Examples is not to present new questions for discussion, but to show that the physical quality of cast-iron is not wholly dependent upon its chemical composition, and that "Keep's Test" will not only always show the proper amount of silicon, but will show the influence of every condition met in foundry practice. Allow me in closing to again quote Mr. Mumford: "There has never been, and there hardly ever can be, a system of foundry testing so complete, and making it so certain that bars made now, or a year from now in one shop or another, shall be so absolutely alike, as 'Keep's Mechanical Analysis.'"

SERIES X.

No. Test.	28 Lbs. Iron in One Ladle. (Rested.)	Dead Load.		Shrinkage.		Chill.
		Stren'th	Deflec'n	Square.	Flat.	
806	Poured at once	.420	.21	.160	.166	.150
807	Poured ¾ minute later	.474	.24	.162	...	.150
808	Poured ¾ minute later	.498	.22	.160	...	.150

SERIES XI.

No. Test.	28 Lbs. Iron in One Crucible. (Rested.)	Dead Load.		Shrinkage.		Chill.
		Stren'th	Deflec'n	Square.	Flat.	
	Mixture Like Series VII. to IX.					
803	Poured at once	.359	.21	.125	.143	.08
804	Poured 1¼ minutes later	.382	.21	.123	.145	.12
805	Poured 1¼ minutes later	.378	.21	.122	....	.06
	One Brand Pig-iron Alone.					
833	Poured at once	.402	.26	.158	.159	.17
834	Poured 1¼ minutes later	.388	.23	.158	.159	.17
835	Poured 1¼ minutes later	.376	.20	.158	.159	.17
836	Poured 1¼ minutes later	.368	.17	.157	.158	.17

SERIES XII.

No. Test.	All Three Poured from One Ladle.	Dead Load.		Shrinkage.		Chill.
		Stren'th	Deflect'n	Square.	Flat.	
814	Very wet mold	.420	.22	.146	.149	.04
815	Regular mold	.430	.23	.136	.142	.04
816	Dry mold	.414	.23	.130	.142	.06
818	Wet mold	.425	.22	.131	.145	.08
819	Regular mold	.468	.25	.132	.143	.08
820	Dry mold	.437	.24	.123	.138	.08
821	Wet mold	.398	.22	.128	.145	.06
822	Regular mold	.392	.22	.130	.146	.06
823	Dry mold	.407	.23	.120	.140	.05
827	Wet mold	.417	.23	.138	.147	.04
828	Regular mold	.417	.24	.129	.144	.05
829	Dry mold	.421	.24	.122	.140	.04
830	Wet mold	.375	.21	.142	.150	.05
831	Regular mold	.387	.22	.140	.148	.04
832	Dry mold	.390	.22	.129	.141	.04

SERIES XIII.

No. Test.	Separate Ladle for Each Test.	Dead Load.		Shrinkage.		Chill.
		Stren'th	Deflect'n	Square.	Flat.	
812	1st iron (after 200 lbs.)	.392	.21	.163	.187	.225
813	1st iron, next ladle	.390	.23	.164	.175	.150
815	Middle of heat	.430	.23	.136	.142	.040
817	Last of heat	.397	.21	132	.148	.075
824	1st iron (after 300 lbs.)	.375	.19	162	.186	.225
825	1st iron (after 600 lbs.)	.415	.21	.163	167	.100
826	Middle of heat	.425	.23	.126	.141	.025

* A paper read before Foundrymen's Association at Philadelphia, June 6th.

Personal.

Our correspondent, Mr. W. H. Wakeman, has accepted the position of engineer for the Boardman Manual Training School, now in course of construction in New Haven.

Chas. F. Foster, late mechanical engineer of the World's Fair, has opened an engineering office at 1411–1412 Manhattan Building, Chicago.

We have seen some photographs and blue prints showing the construction of the latest addition to the shops of the Brown & Sharpe Mfg. Co., which is now being erected. This addition is an extension of the first or No. 1 building, and when it is done this building (the No. 1) will be in the form of a hollow square and will have 133,000 square feet of floor space, the addition having 50,000 feet of this. The frame work supporting the floors in this building is of steel beams and columns, with walls of brick. This addition will make the total floor space of all the buildings 272,500 square feet, or about 6¼ acres.

A friend sends us a clipping from a contemporary—one of the leading electrical journals—in which there is supposed to be an illustrated description of an "eight-spindle automatic drill," this being the title of the article and the legend under the engraving. The engraving, however, is a Garvin universal milling machine, under full sail, so to speak, and when we are gravely informed that this machine "with $\frac{3}{16}$ inch drills will produce about 5,000 pieces per day, only requiring the attention of a boy to drop in and remove the work and throw the starting lever," we are somewhat shocked. "Of all sad words of tongue or pen the saddest are these: It might have been."

It is said that large quantities of nails have been purchased in this country for shipment to Australia by the way of England.

AMERICAN MACHINIST

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Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.

We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.

We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.

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Strikes and Arbitration.

The coal strike now in progress in this country is in its present and possible effects one of the most disastrous that has ever occurred. At this writing, in many parts of the country, industrial operations are seriously interfered with, railroad trains are withdrawn and steamboats are idle; even transatlantic transportation is to some extent interfered with. Like all great industrial strikes, the effects of this one are not confined to those immediately interested, but extend to every part of the country, and directly or indirectly to nearly every industry. As is almost universally the case where such results obtain, opinion is divided as to the responsibility for these conditions. We confess to being unable to decide the question of right and wrong as between the operatives and operators, and have absolutely no side in the matter. But, without attempting to write either side up or down, we can, in common with many others, see nothing but cause for regret in the fact that so near the year 1900 the barbarous practice of trying to settle labor disputes by strikes is necessary. The wisdom of man should long before this have devised some better method, if it has not already done so in arbitration.

No law can prevent men from refusing to work except upon their own terms, and no law can compel men to employ others except upon such terms as they—the employers—shall dictate. The strike, the lockout and the blacklist are things that cannot be prevented by legislation. But they do not in reality settle labor disputes. No man is convinced simply because he is beaten On the contrary, he only awaits the opportunity to renew the struggle. The only hope of reasonable and satisfactory settlement appears to be in arbitration, and this must be voluntary. The more the lawmakers attempt to meddle the worse the matter becomes.

So long as present methods exist it is silly to scold full-grown workmen as if they were school-children. It is a useless task, that of setting up an array of figures showing them the loss of wages resulting from a long-continued strike; useless, because if a man happens to work for another it does not follow that he has nothing in his vision but dollars and cents. He has something else in his vision and he ought to have. Precisely the same is true of the employers of labor.

Strikes occur in many instances—generally, perhaps—because one of the parties is taking an unwarranted advantage, and men will fight harder for principle than they will for dollars and cents, which is entirely to their credit. If this were not so the world would not be fit to live in. But men who stand up for right because it is right are usually susceptible to reason, and it should be easy for such men to see that unprejudiced arbitrators may be able to see the right better than they can. We have still hopes that the good sense of the American people will bring them to see and act upon this.

It is rather evident that attempts to break up organizations of either employes or employers will never prevent strikes, but will, on the contrary, tend to foster them. This has been pretty well demonstrated in this country and still better in Britain, where such attempts have been abandoned. In fact, a recent English writer takes the ground that the complete organization of employers on one hand and employes on the other furnishes the best reason for believing that strikes there will become rarer and rarer year by year. His reasoning—and it appears to us to be good—is, that as each party finds the other prepared to assert its rights their mutual rights will be respected, or that, at least, like two equally prepared naval powers they will hesitate about trying their strength, and settle their differences by milder means.

We are not of those that believe that the time will come when employes and employers will be able always to see alike as to labor and wages. This would be asking too much of human nature. Nor do we believe that arbitration can be enforced; if it comes at all it must be through the efforts of the best thinkers amongst those who pay and those who receive wages. It would seem that not many strikes like that of the coal miners would be required to lead such men to the conclusion that arbitration is the better method of effecting a settlement.

The greatest difficulty at the present time in bringing about adjustment by arbitration is that one party or the other is almost certain to announce that it has nothing to arbitrate. Of course, this settles the matter, although it would seem to the unprejudiced that the party that was sure of the justice of its claims should have no hesitancy in having them pronounced upon by unprejudiced arbitrators.

It seems hardly necessary to say that arbitration should precede any overt act, such as a strike or lockout; should be resorted to before passions are aroused that inevitably blind reason and lead to results more or less unsatisfactory, even if the trouble is eventually settled by arbitration.

Strikes settle nothing except the relative strength of the contending parties. Arbitration would, or should, settle differences on the basis of justice.

There may possibly be some small degree of comfort in the result of some investigations made by the professors who publish the *Yale Review* into the question of the comparative severity of panics or industrial and commercial depressions in this country.

According to this, and so far as can be judged by the proportion of mercantile failures to total volume of business, the panic of 1893 was somewhat less disastrous than that of 1873 and a great deal less than that of 1857.

The trouble with making such comparisons seems to be, however, that commercial failures do not necessarily show the shrinkage in business and manufacturing. In other words, the shrinkage in volume of business might be the same proportionately, and yet commercial failures be more or less, according to other conditions, such as the amount and general character of indebtedness, banking methods, currency, etc. It is not the proportion of failures alone that makes hardship, but the shrinkage of commerce and manufactures by which men and women are deprived of the opportunity to earn a living.

Speaking of railroad receiverships, the same authority in speaking of a considerable share of our roads says, "the crisis has simply served to prevent them from keeping up false appearances any longer."

An exception to the previously referred to series of *successful* tests of armor plates and projectiles was the one made at Indian Head, May 19th, in which the plate (a Harveyized 18-inch specimen) was cracked and ruined by a single shot from a 12 inch rifle throwing a Carpenter shell weighing 850 pounds at a velocity of 1,465 feet per second. The test, though a disappointment to the experts and to the plate men, and regarded as a failure, is, of course, a success for the shell and the gun, though this feature is made no account of, because at that particular time the shell and gun were not being tested.

The plate was made at Bethlehem, a works against which there has never been the breadth of a suspicion of underhanded work, and it is entirely probable that the plate tested was somewhat inferior to the lot of which it was the chance-selected representative. In fact, the cracks made in the plate are said to have shown that it was defective.

An American Bicycle Factory in France.

A. Clements, the well-known bicycle manufacturer of Paris, France, has recently returned home after an inspection of American bicycle factories and tool-building establishments. He expresses himself as of the opinion that the art of bicycle manufacture is much more highly developed here than anywhere else, and in his new factory, which is to be the largest and finest in the world, with a capacity of 150 machines for every working day in the year, he will put in an equipment of American machinery and tools chiefly, for which he closed the contracts during his visit. The amount represented by these contracts is about $300,000, of which about one third is for a ball-making plant capable of making 1,000,000 balls per month, the invention of John J. Grant, and to be supplied by the Cleveland Machine Screw Co.

The Third Avenue Railway Company, of New York, deserves a good word for having raised the wages of conductors twenty five cents a day without their knowledge and consent. A similar increase will undoubtedly be made on the Broadway road.

The New England Water Works Association will hold its Thirteenth Annual Convention at Boston, Mass., on June 14th, 15th and 16th. Headquarters will be at United States Hotel. A number of papers will be presented and discussed, and business of interest will be transacted. There will be an excursion by boat on one of the days of meeting, through the courtesy of the city of Boston.

Literary Notes.

We are in receipt of a pamphlet reprint of a paper read by Robert Cartwright before the American Society of Civil Engineers on "The Electric Station of the Citizens Light and Power Company," of Rochester, N. Y. The discussion of the paper is also appended. The arrangement of the power plant is such as to use both water and steam power. Rope-driving is employed. The author, who was the engineer in charge, goes very completely into the details of the construction of the plant, masonry and machinery, several illustrations being given, and the whole forming a very interesting addition to the literature of the subject.

THE MAGNETO HAND TELEPHONE. Its Construction, Fitting Up and Adaptability to Every-day Use. By Norman Hughes, Electrician.

Readers who are seeking general information in regard to the magneto hand telephone, its construction, and the principles involved in the electrical transmission of speech, will find this little book of 80 pages a useful one, and of considerable aid to those who wish to erect and maintain a small private line. The different chapters treat on the construction of magneto telephones; outdoor and indoor lines; signaling apparatus; open and closed circuit batteries; practical operations; how to test the line; battery telephone; three instruments on one line, and general remarks. All these subjects are treated in a practical and interesting manner. The book is published by Spon & Chamberlain, 12 Cortlandt street, New York. Price, $1.00.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(268) G. H. E., Cincinnati, O., writes: Kindly inform me through your columns as fully as convenient, what materials are generally used, and the process employed in tempering copper, both large and small quantities? *A.*—Attempts at tempering copper have been made with varied results, but the process followed in each case has been carefully guarded from giving it publicity, so that we cannot give you the information desired.

(269) C. E. K., Worcester, Mass., writes: I would like you to settle a dispute between us. It is this: A says that a belt tightener or idler should be placed on the tight side of the belt or pulling side, next to the driv-

ing pulley; and B says it should be on the slack side of the belt. Who is right? The pulleys are equal in diameter, and the belt runs in a horizontal direction. *A.*—The common practice is to apply the tightening pulley to the slack side of the belt near the driven pulley.

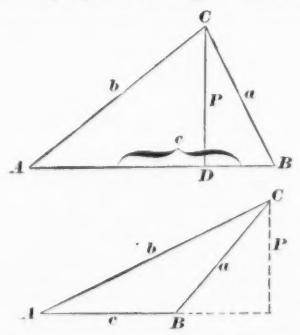
(270) H. L, El Paso, Tex., writes: Please inform me by what process I can silver-plate tin and lead, and mention some good reliable work treating on the same. *A.*—These materials can be silvered by the electro-plating process. To silver lead it is advisable to give it first a coating of copper. One of the best books treating on this subject is the "Complete Treatise on the Electro-deposition of Metals," by Dr. George Langbein, published by Henry Carey Baird & Co., Philadelphia, Pa

(271) H. A. L., Chicago, Ill., writes: Please give me some information in regard to a cement or glue for fastening glass to metal, and which will not be affected by exposure to moisture or rain? *A.*—We should try the following: Mix 2 ounces of a thick solution of glue with 1 ounce linseed oil varnish, or ½ ounce Venice turpentine; boil them together, stirring them until they mix as thoroughly as possible. The pieces cemented should be tied together for 2 or 3 days. This cement will firmly attach any metallic substance to glass or porcelain.

(272) G. R, Ontario, Canada, asks: What power will be required for driving a steam launch 42 feet long, 6½ feet beam, drawing 42 inches aft and 12 inches forward; speed 14 miles per hour? *A.*—About 60 horse-power. 2. What should be the size of cylinders for a fore and aft compound engine to drive the launch at the required speed; steam pressure 150 pounds? *A.*—High-pressure cylinder 5 inches diameter, low-pressure cylinder 10 inches diameter, both 7 inches stroke. 3. What should be the diameter and pitch of propeller, and the number of revolutions? *A.*—Diameter of propeller 24 inches, pitch 42 inches, number of revolutions about 520 per minute.

(273) J. D. W., Chicago, Ill., writes: Please inform me of a good book treating on electric motors and rheostats. I would like to get a book or books that will give me information on these two subjects, and such as I can understand, because I am not very well learned in electricity. *A.*—Our advice to you is to start the study of electricity from the beginning; by so doing you will save time in the end and be able to apply your knowledge with greater confidence to practical work, and with greater certainty of obtaining the desired results, than by simply studying a special branch of the subject. "Magnetism and Electricity," by S. P. Thompson, is a good book for beginners.

(274) E. H. B., Newark, N. J., writes: Please give me the formulas for solving the problems relating to triangles as per inclosed sketches? *A.*—For the want of sufficient data, two of the given problems cannot be solved. All the others can be solved by the important relations existing between the sides and trigonometrical functions of the angles of oblique angled triangles. Thus: The sides of any plane triangle are proportional to the sines of the angles opposite. Let *A B C*, in the accompanying illustration, be any plane triangle. Draw from



either angle, as *C*, a perpendicular upon the opposite side, or upon that side produced. Designate the angles by *A*, *B* and *C*, the sides opposite by *a*, *b* and *c*, and the perpendicular by *P*. Now, from the right-angled triangle *A D C* we have $P = b$ sin. *A*, also from *C D B*, $P = a$ sin. *B*; sin. *A B C* in the second figure being = sin. *C B D*. Hence, equating the values of *P*, *b* sin. $A = a$ sin. *B*, or $a : b ::$ sin. *A* : sin. *B*. From this proportion you can solve the given problems.

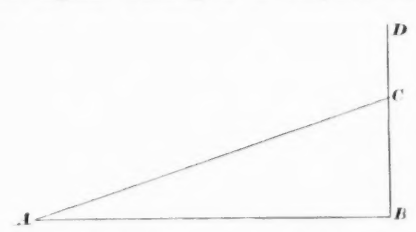
(275) G. E., Philadelphia, Pa., writes: Please give me a receipt for a leather cement which will resist the solvent action of water? *A.*—Dissolve a quantity of gutta percha in chloroform in quantity to make a fluid of honey-like consistence. When spread it will dry in a few moments. Heat the surfaces at a fire or gas flame until softened, and apply them together. This cement is water-proof, and will answer almost anywhere, unless exposed to heat which will soften it. 2. Is there any kind of paper which is fire-proof and can be written on, or is there any method of fire-proofing paper which has already been written on? *A.*—To make paper fire proof, take a solution of alum and dip the paper into it, then throw it over a line to dry. This is suitable for all sorts of paper whether plain or colored, as well as textile fabrics. Try a slip of paper in the flame of a candle, and if not sufficiently prepared, dip and try it a second time. To make paper fire-proof after it has been written on, probably the following will be a better method: Dip in a solution of soluble glass of 25° Baumé; next neutralizing the alkali by dilution of muriatic acid of 10° Baumé, while hot, and drying by the atmosphere. Fire cannot then destroy the texture of the paper. 3. Do you know of any cement or composition which will harden in about a day's time, is fire-proof, and can, after having hardened, be broken up, and dissolved or otherwise treated so as to bring it back to its original state? *A.*—We do not know of any cement that will answer all the conditions mentioned. 4.—Please give me the composition of plaster of paris? *A.*—It consists simply of calcined gypsum, that is gypsum from which the water has been driven off by heat.

(276) C. E. J., Bonne Terre, Mo., writes: I want to make a lazy tong which is to be used on a 23x48-inch engine. Please give dimensions, distance of stake from crosshead, and also give the address of a party from whom it can be bought? *A.*—The lazy tongs or pantograph is usually made of cherry wood; the long levers are 1½ inches wide and $\frac{5}{16}$ inch thick; the distance between centers of pivots is 16 inches. Every alternate lever is made of two strips of the above dimensions, and the others are made of single strips, passing between the strips of the double ones. The pivot holes should be bushed, and the pivots nicely fitted. The end pivots should have a projection below of, say, 2 inches, with the end somewhat pointed. The engine crosshead must have a vertical hole in it somewhere to receive the projection of one of the pivots. A stake is set in the floor near the guides having a socket in its top to receive the other pivot. The stake socket must be level with the crosshead socket and placed directly opposite the crosshead socket when the latter is at midstroke. The stake should be set at such a distance from the guides that the cord will lead off parallel with the guides, otherwise a guide pulley will be required. For high-speed engines it is best to adopt a form of pantograph having four joints only, as such a one is better adapted to high speeds than one with greater number of joints. Unless you have suitable tools for making a pantograph you will have considerable fun, the least variation in the location of the pivot holes will cause a failure in the action of the levers. If the thing will close up nicely and open out nicely it is all right, otherwise it is all wrong. You can buy pantographs from any dealer in or manufacturer of indicators, the addresses of some of these are given in our advertising columns.

(277) L J. F., Ausable Forks, N. J., writes: Kindly inform me which is the right method of connecting an ordinary steam boiler feed-pipe, in front or back of boiler. *A.*—There is a great diversity of opinion respecting the best position for the introduction of the feed-water. A common practice is to admit it near the bottom in all kinds of boilers. But it must be evident that easy accessibility to the check valves, or any other valves that may be used in connection with the pipes, is a matter which should receive due consideration, hence many boilers at present in use, have the feed-pipe either attached to the front end of the boiler or to the top of the boiler near the front. It is also important that the comparatively cold feed-water should not come in direct contact with any of the hot surfaces in the boiler. Another circumstance sometimes lost sight of is the importance of preventing as much of the water as possible from being forced back through the feed inlet, in case the check valves do not act properly, and thus suddenly draining the hot surfaces dry. To meet all these requirements and avoid trouble, we should place a horizontal pipe, perforated on top and running nearly throughout the length of the boiler, about one or two inches below the lowest water level in the boiler; or, if the feed-water contains much bicarbonate of lime in solution, some engineers recommend a trough or pipe of large diameter, cut open on top, in place of the perforated pipe. The feed-water entering through the front of the boiler, or through the top of the boiler, is led into the perforated pipe or trough and distributed without doing any injury to the hot surfaces, and in case the check valve does not work properly a sudden drainage of the boiler cannot take place. This arrangement is considered to be a good one by many engineers.

(278) T. E., New York, writes: A tank 18 feet long and 60 inches diameter is filled two-thirds with water, what will be the height of the water in the tank? Please give rule for solving this and similar problems. The tank is placed in a horizontal position. *A.*—The water surface divides the cross-sectional area into two segments. We shall first find the height of the segment above the surface of the water. The best way to accomplish this is by means of a table of areas of circular segments, the diameter of the circle being equal to 1. This table will be found in Trautwine's, Haswell's, and many other Engineer's Pocket books. The rule is: Divide the area of the segment by the square of the diameter of the corresponding circle, look for quotient in the column of areas in the table, take out the corresponding height, and multiply it by the diameter of the circle; the product will be the required height of the segment. In your example, we have a circle 60 inches diameter, its area is 2,827.4 square inches. The area of the segment above the water level is ⅓ of this, $\frac{2827.4}{3} = 942.466$ square inches; dividing this by the square of the diameter ($60 \times 60 = 3{,}600$) we have $\frac{942.466}{3{,}600} = 0.2618$; looking for this number in the column of areas in the table, we find a corresponding height of .367, and multiplying this by the diameter of the circle, we have $.367 \times 60 = 22.02$ inches for the height of the segment above the surface of the water. The height of water from the bottom of the tank will be $60 - 22.02 = 37.92$ inches. From this it will be seen that the length of the tank does not enter into the computation. In a similar way, the height of any segment may be found when its area and the diameter of the circle is known.

(279) J. W., ——, asks: Are bored guides for steam engines considered to be as good as flat or V shaped guides? *A.*—Bored guides and turned crossheads can be made true with less difficulty than other forms; but, on the other hand, it is possible that with turned crossheads, other things being equal, the friction will be somewhat greater than with flat surfaces. However, the form of guides and crossheads is, to a great extent, a matter of individual preference. 2. What is the proportion between the width and length of bored guides? *A.*—There is no definite proportion between these two dimensions. The length of guides depends much on the length of crosshead, and the latter depends on the pressure between the guides and crosshead, which in high speed engines should not exceed 50 pounds per square inch of working surface; for engines working at a comparatively



slow speed, this pressure may be exceeded. We should adopt the following method for determining the length and width of crosshead, and finally the length of guides. In the first place, we find the pressure between the guides and crosshead as follows: Draw the lines *A B* and *B D* perpendicular to each other; make *B C* equal to the length of the crank, and from *C* as a center and a radius *A C* equal to the length of the connecting rod draw a short arc, cutting *A B* in the point *A*. Now, the length of *A B* will represent the total steam pressure on the piston, and the length *B C* will represent the pressure between the guides and crosshead. This pressure will be as much smaller than the pressure on the piston as *B C* is shorter than *A B*. To make this clear, we will take the following example: Diameter of cylinder 16 inches, stroke 24 inches, pressure on the piston is 100 pounds per square inch, length of connecting rod 72 inches; find the pressure between the crosshead and guides. In this case the length of *B C* will be $\frac{24}{2} = 12$ inches, *A C* = 72 inches and $A B = \sqrt{72^2 - 12^2} = 71$ inches, very nearly; of course, this length can be obtained by measurement instead of computation, as we have done. The area of a piston 16 inches diameter is 201 square inches, hence the total pressure on the piston will be $201 \times 100 = 20{,}100$ pounds, and this pressure is represented by the length of the line *A B*; but since the length of *B C* represents a pressure as much smaller as *B C* is shorter than *A B*, we have:

$$A B : B C :: 20{,}100 : x, \quad \text{or}$$
$$71 : 12 :: 20{,}100 : 3{,}395;$$

this shows us that the pressure between the guides and crosshead is 3,395 pounds. If, now, we decide that the pressure per square inch of crosshead surface must not exceed 50 pounds, then we require a surface of $\frac{3{,}395}{50} = 67.9$ square inches. And if the length of crosshead is to be equal to ½ of the stroke, a proportion frequently adopted for this kind of engine, then the width of crosshead will be $\frac{67.9}{12} = 5\,66$, say $5\frac{2}{3}$ inches. Finally, if the crosshead is to travel within ¼ inch of the ends of the guides, the length of the guides will be $24 + 5\frac{2}{3} + 1 = 30\frac{2}{3}$ inches. 3. What prevents crossheads in bored guides from turning sideways other than the connecting rod connections? *A.*—Nothing. 4. Are any pieces employed to prevent such turning? *A.*—No. 5. Is not a steel shoe on cast-iron guides about as good a practice as any other? *A.*—We prefer cast-iron shoes for cast iron guides.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Cheap 2d h'nd lathes, planers, shapers, drill presses punch presses, etc. Am. Tool Works. Clev'd, O.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

"Instruction in Hard Soldering." Rowell, post free, 75 cents. Spon & Chamberlain, 12 Cortlandt street, New York.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co., New York, N. Y.; Cincinnati, O., & Stroudsburg, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

The Relation of the Drawing Office to the Shop in Manufacturing.*

BY A. W. ROBINSON, SOUTH MILWAUKEE, WIS.

The purpose of this paper is to describe the system employed by the writer in the drawing office of his company in the hope that some of the points may be of use to members of the society.

The drawing office is the origin of thought and action for the entire works as far as the design and construction of its product are concerned. It is responsible for the accuracy of its drawings and orders, and its authority should be unquestioned and above reproach in the shop. The shopmen should habitually trust and adhere to their drawings, and their faith should not prove to be misplaced. To maintain this there must be unceasing care and vigilance on the part of the office, and full adaptation to the shop needs and capabilities. It goes without saying that every drawing office, whether employing one draftsman or a hundred, should have its system and methods adapted to the needs of the establishment with which it is connected. As these needs vary with each case, it is not to be supposed that the system about to be described will be of universal application. It will be well then

* Presented at the Montreal Meeting (June, 1894) of the American Society of Mechanical Engineers.

to state in a general way the conditions which this system is intended to meet. We will assume, therefore, that the office employs from ten to fifteen skilled draftsmen, and is in connection with a manufacturing establishment, doing a general engineering business in which there is comparatively little duplication of orders, and in which single orders frequently involve a large amount of detail, of which it is essential to keep exact records. It is also assumed that the drawing office is invested with the sole right and authority to issue orders to the shop for all new work, or all work in which there are changes and variations from previous similar work.

The practice of issuing verbal orders or directions for the conduct of work is productive of misunderstanding and confusion. When no evidence of authority exists no responsibility can be fixed. It is, therefore, advisable to have a system of written orders to all departments whereby the duty of those concerned is clearly defined, and the responsibility can be fixed for dereliction of duty.

Shop Orders.—An order being once entered on the books of the company, the procedure is as follows: The business office issues a written order to both the drawing office and the shop upon a blank, which merely states the general name of the machine, the time of delivery promised, and the number of specifications to be worked to, if any, and the number by which the order is to be known. It is the duty of the drawing office to prepare such specifications beforehand when necessary. On the receipt of these orders in the shop, if it be a repair or duplicate of something already made, so that the shop superintendent has the information by which to execute it, he does so. If, however, it is new, or in any sense special work, he cannot proceed until the orders come down from the drawing office.

The drawing office issues orders upon the pattern shop and foundry by means of blanks headed "foundry" or "pattern shop," as the case may be, arranged thus:

B. S. S. & D. CO. ENGINEERING DEPARTMENT.

FOUNDRY ORDER.

ORDER NO.	DATE. 189	DRAFTSMAN.

Countersigned by	Examined by

These are manifolded in triplicate, and can be made out by any draftsman to whom the job is delegated, but must be signed by the chief engineer, or, in his absence, the chief draftsman. The two copies are then sent down to the shop superintendent's office, who keeps one on file for his own reference and information, and immediately sends the other to the foreman of the department for which it is intended. In this way the shop superintendent retains control of his men in the different departments, and has knowledge of the orders that are issued. He alone is responsible for their proper execution, and undue interference of the draftsman with the foremen or workmen is obviated.

It is also the duty of the drawing office to order all raw material for new and special work, that is not regularly kept in stock. This is done by blank as follows:

B. S. S. & D. CO. ENGINEERING DEPARTMENT.

DATE. 189	Please order the following for Order No.
Ship	
Draftsman	Countersigned, Chief Engineer.

These are simply requisitions on the business office, and the copy goes to the storekeeper as a statement that the articles noted have been this day ordered. He will therefore be expecting them, and on their receipt will at once know for what order they are intended. His copy of the manifold reads, "The following material has this day been ordered for order No. —."

Written orders are not issued from the drawing office to any other departments, except the pattern shop and foundry. Drawings and sketch sheets are issued to the other departments, as machine, smith and erecting shops, etc. These pass through the hands of the shop superintendent, and in themselves constitute an order to make what they represent or call for, provided they are covered by the original general order from the business office and bear the same order number.

By means of these written orders to each department, each foreman knows definitely what work he has on hand, and all responsibility for errors or delinquencies is at once traceable to the culprit.

The shop superintendent is also empowered to issue written orders to his foremen in all departments, for all work which does not require information from or the authority of the drawing office. For these he uses his own blanks—those of the drawing office being labeled "Engineering Department."

It frequently happens that on large orders involving much detail, it is desirable to push the construction of parts as fast as they are determined upon before the completion of the general design. In these days of urgency and high pressure this is almost a necessary evil, but should be pursued with caution in the drawing office, lest difficulty be found in fitting the later part of the design to the earlier. Under this system of written orders the parts can be ordered in as fast as they are ready, even though the shop superintendent is as yet uninformed as to the balance of it, and does not know of what the complete order is to consist.

When the drawing-office work on the order is completed an order list is made out and typewritten in duplicate. The order list enumerates in detail all the items making up the complete order, and is divided up into headings such as (1) castings, (2) forgings, (3) miscellaneous, (4) special material ordered outside, and so on. For each item is given a reference number of the drawing or sketch sheet on which it is shown, and it is or should be shown thereon so fully and definitely that no further questions need be asked. This order list is essential: 1st, to inform the shop definitely of what the work consists; 2d, to refer the shop to a source of information concerning each and every item; 3d, to form a shipping list so that in shipment nothing will be overlooked that should be sent; 4th, to form a permament record by which repairs may be readily identified, and from which future machines may be compiled or adapted. These order lists are press-copied in a book for the purpose.

Drawings.—The primary function of a shop drawing is to answer the shopman's questions, and indeed it may be said that this is its only function. There are certain things connected with the material, form, dimensions, finishing, fitting and erecting of a machine and each part of it that each department needs to know. Sometimes in simple cases the various processes of pattern-making, finishing and erecting can be defined on one drawing, and in other cases separate drawings containing separate information for the different processes are demanded. It is important to have all the necessary information conveyed on a drawing in a direct and legible manner, and that the views be so chosen as to represent the object in the simplest way. Let the draftsman, on beginning to make a shop drawing, say to himself, "Now what does the fellow who is to make this want to know," and then let him put down just that information and no more, but be sure and get it all on. Refrain from all superfluous lines and marks, and make the drawings so plain that "he who runs may read them."

The mere ability to make lines and circles and projections is really the least important and the least valuable part of a draftsman's skill. Neatness and accuracy of drawing is desirable, but if it is obtained with the expenditure of an undue amount of time, and does not carry with it a practical knowledge of shop needs and shop processes, it ceases to be a virtue.

The following set of rules for the drawing office have been found to be useful and to work well. They contain some points that a good draftsman ought to know, but they are incorporated as reminders, and as being necessary to preserve uniformity of practice among changing draftsmen.

DRAWING OFFICE RULES.—SHOP DRAWINGS.

1. All drawings shall be of the uniform size of 23″x36″.

2. All detail drawings for use in the shop shall consist of whole standard sheets, half standard sheets and sketch sheets. Half sheets shall be 18″x23″, formed by ruling a line across the center of standard size sheets as filed, the blue prints only to be cut, and mounted and varnished, when necessary.

3. The sketch sheets shall be 8″x11″, and shall be used for all simple details, forgings, for bolt lists, and for all temporary work capable of being shown in this way. All standard machines shall be fully drawn out and blue printed. The sketch sheets shall be made with indelible pencil or copying ink and press-copied in the book for the purpose. The information on the sketch sheets shall be as complete as that specified for drawings.

CHARACTER OF SHOP DRAWINGS.

4. A shop drawing is to be considered as an order or instructions to the shop, and not merely as a statement or illustration. For this purpose it must convey clearly all the information needed to make and finish the article.

5. Every dimension necessary to the execution of the work is to be clearly stated by figures on the drawing, so that no measurement need be taken in the shop by scale. All measurements to be given with reference to the base or starting point from which the work should be laid out. In comparatively simple constructions the several parts are to be shown together complete, although each part must be figured independently, and details supplied, if necessary, by sketch sheet. In more complicated forms each part should be detailed by itself and a general drawing made showing the thing complete. No details should be sent out without putting them together on a drawing, or taking them from a general drawing, so as to insure their fitness. Unnecessary duplication of views to be avoided, except in display or advertising drawings.

6. All figured dimensions on drawings to be plain, round vertical figures, not less than ⅛ inch high, and formed by a line of uniform width and sufficiently heavy to insure printing well. No thin, sloping or doubtful figures or diagonal-barred fractions will be tolerated. All figured dimensions below 3 feet to be expressed in inches.

7. All center lines to be alternate dot and dash in fine black line. All dimension lines to be in continuous red lines, with a central space for the figure, and of such strength as to show on blue print more faintly than lines of drawing. Lines of drawing to be bold and clearly defined in proportion to the scale, and to be shade lined by making the right-hand and bottom lines heavier. No ornamental shading or other "frills" allowed on shop drawings.

TITLE.

8. Every drawing, whether whole or half-sheet, shall have the title, date, scale, and number of the sheet placed in lower right-hand corner. One man will be detailed for this duty, to secure uniformity.

9. The name of the drawing, as given in the title, is invariably to consist of two divisions in one line separated by a hyphen. The first division is to state the general name of the thing or machine, and the second division is to clearly designate the part or parts represented (or if a general view should so state). The wording of the titles should be submitted to the chief engineer or head draftsman for approval.

DRAWING SYMBOLS.

10. Detail shop drawings should state:

(1) The pattern number of every casting in plain figures of larger size than the dimension figures.

(2) The number of each piece required for one set. This should be written in one word (not figures) and followed by symbol of material.

(3) The material of which the parts so ordered are made, using symbols as follows:

C. I.—Cast-iron.	Bs.—Brass.
W. I.—Wrought-iron.	Bz.—Bronze.
C. S.—Cast Steel.	Bbt.—Babbitt.
M. S.—Machinery Steel.	V. F.—Vulcanized Fiber.
H. S.—Hammered Steel.	C.R S.—Cold Rolled Steel.

Other materials write full name.

(4) The kind of finish on each of the different parts will be indicated by a letter preceding the figured dimensions, as follows:

F.—Means "Finish," and indicates that the surfaces to which it applies are to be machined or dressed in suitable manner to size stated.

F. B.—Means "Finished Bright," or polished.

G. F.—Means "Grinding Finish," and indicates that the only finish to be allowed is that necessary for grinding.

When no letter precedes the figured dimension it is understood that the part is to be left black or rough. In cases where finish might be presumed but not required, follow the figured dimension by the word "Cast" if a casting, and "Rough" if a forging.

(5) A reference list of sketch sheets that may be used for detail illustrations.

SKETCH BOOKS.

11. Each draftsman will be supplied with a sketch book by the company, and in which he shall make all his notes, calculations and data referring to his work, and under no circumstances shall original work be done on loose sheets and transcribed into these books. No effort should be made at neatness or nicety in these books, but each entry should invariably be commenced with the name of the thing and the date, and full notes made of data on which the calculations were based, and the results obtained clearly stated. These books are to be the property of the company.

INDEX FOR DRAWINGS.

12. An index book for drawings will be kept in the drawing office by the clerk. This book will be divided into as many divisions as there are drawers, with provision for indexing 100 drawings in each drawer. The names of the drawings will be added to the various divisions according to their classification. The system of numbering shall be as follows:

13. Each drawer shall be numbered consecutively, and shall contain drawings devoted to a certain class of work, which shall be indicated on the drawer label. The drawing number shall consist of two or more digits with a decimal point between them. The whole number shall indicate the number of the drawer, and the figures after the decimal point shall indicate the serial number of the drawing in that drawer. For example: Drawing No. 5.16 is the 16th sheet in Drawer No. 5, and Drawing No. 75.96 is the 96th sheet in Drawer No. 75. Not more than 99 drawings shall be put in one drawer, except in exceptional cases.

14. Sketch sheets will bear the number of the letter and page of the letter book, preceded by the letter S, to distinguish them from drawings, and will be indexed in their own impression book, but not in the drawing index book. They will be referred to on general drawings of which they are details, and will also bear the number of such drawing.

15. When making a new drawing the draftsman will apply to the clerk for a number, and will be allotted the first unappropriated number in the division to which the drawing will belong.

16. On completion of every drawing or

sketch sheet it must be examined and initialed by the engineer before being issued, and the following entries made in books kept for the purpose :

(*a*) Record of blue prints and sketch sheets issued to shop, giving date, number, and title.

(*b*) Drawing index.—Record in day-book the number, title, and sub title, draftsman and date.

(*c*) Pattern index.—Record in day-book the number, classification and correct name of patterns, with remarks and date.

Each draftsman will see that these entries are properly made.

PATTERNS.

17. All patterns shall be numbered with the number of the drawing from which they are first made, followed by a letter indicating its serial on that drawing. For example, if four patterns are shown in detail on drawing No. 36.50, the patterns shall be numbered 36 50A, 36 50B, 36 50C, 36 50D. When existing patterns are utilized in a new design or machine, their original number is to be noted on the drawing on which they are shown in their new employment.

18. Upon receiving formal notice from the pattern shop that patterns are ready for inspection, the draftsman connected with the order shall examine same and issue foundry order for the casting. The date of inspection and name of inspector shall be entered upon the patternmaker's report at the time of making such inspection.

The sketch sheets referred to in these rules are 8x11 inches in size. They are of stiff cardboard, and the heading is printed in copying ink. The sketch is made with an aniline copying pencil, the "Eagle No. 2" in wood being used. They are press-copied in books for the purpose, and several books are used for different classifications of work. The books are of slightly heavier tissue paper than is commonly used for correspondence, and have 500 leaves each, numbered consecutively throughout the series, so that the number of a sketch sheet is never duplicated. In this system there are six books for copying sketch sheets, representing as many classes of work, and these divisions will readily suggest themselves as required for any particular case.

The use of these sketch sheets is espe cially for work which does not require to be often duplicated, and for giving quick dispatch to emergency work. A free hand sketch can be made, copied, and issued in this way in ten minutes, while the regular process of drawing, tracing, blue-printing, and waiting for the latter to dry, or the sun to shine, may consume hours They have the additional advantage of being more convenient to handle and file away in the shop than blue prints, and they save multiplication of tracings and consequent drawer space. The copies being in book form cannot be lost and are easily indexed and consulted. Sketch sheets are convenient for rapid detailing of forging and small parts, and such parts need, therefore, to be merely indicated on the general or erecting plan, and reference numbers given of the sketch sheets. The sketch sheets will also all appear as items in the order list.

In addition to the stiff card sketch sheet, it is convenient to have a "Drawing Office Memorandum" blank. This is a copying-ink heading printed on a sheet of letter paper, and is used for order lists and all sketch matter sent abroad from the drawing office.

After copying, the sketch sheet, if for permanent use, is sized with a mucilage, composed of gum tragacanth and water, and then varnished with white shellac and alcohol. The sizing is to keep the lines of the sketch from running while varnishing.

Two necessary articles of office furniture are the drawing table and the blue print frame. So many excellent forms of these have been devised that it seems hardly necessary to refer to them in this connection, but sometime hereafter occasion will be taken to describe types which have the merit of cheapness and effectiveness.

It is our practice not to finish original drawings, but to trace from them on tracing cloth. These tracings are used only to print from and are filed away in a fire-proof vault. Two prints are made of each tracing as soon as finished, one for the shop (or more if necessary) and one to file away in the drawers of the office. These drawers are 24 inches × 38 inches × 2 inches, and are each calculated to hold a maximum of 100 prints. In this way the tracings are preserved from risk of fire and loss and from the wear of frequent handling.

As a rule each draftsman makes his own tracings, and only skilled draftsmen are employed. The writer does not advocate the employment of cheap draftsmen to trace shop drawings from the originals of the designer. If this is done the designer must finish his original to entire completeness before turning it over to the tracer, thus consuming additional time and running more risk of errors and omissions than if he traced it himself. A skillful draftsman will merely block out his entire work on the original and give his whole thought to the perfection of his design. In the tracing he can re-arrange his drawing if necessary, and the time occupied in tracing is usually much less than that employed in working out and perfecting the design, and a draftsman, worth $120 per month, will usually trace twice as fast as one worth $60, and do it better.

The titles on drawings are mainly done by rubber stamps, giving the name of the company, the number of the drawing, and having spaces for the insertion of name, date and scale.

Some experimenting was done to find a suitable stamp ink for tracing cloth. Printers' ink was tried, but it rubs off and does not dry satisfactorily. A special lithographic ink is used, which is similar to printers' ink, but with addition of a dryer. It is applied to the stamp by a composition roller in similar manner to printers' ink and gives a black impression which blue-prints well. The number stamp has movable type.

As a rule it pays to employ only high class labor in the drawing office. A draftsman puts his own impress on his work, his individuality goes into it, even if closely supervised, and it is upon the perfection of detail that the success or failure of a new design mainly depends; it is important that the draftsman entrusted with it shall have the necessary skill and ability.

We have appliances for testing the efficiency of almost every known mechanism, but who can measure the efficiency of a draftsman. We appreciate the economic value of good steam distribution and the like, but too often is the efficiency of the draftsman neglected, and thousands of dollars spent in the construction of work which would have yielded much better results if a little more brains had been used in its design.

In conclusion, the writer would say: Do not have so much system that it is difficult to work to or burdensome to carry out. A few simple rules, faithfully adhered to, are better than the most elaborate system which is loosely or imperfectly carried out. The object of a system is to define the duties of each man and to fix the responsibility of dereliction of duty.

In order to avoid the necessity of transforming circular into rectilinear motion in the case of electric pumps operating under high lifts, Messrs. Dumont, of Lille, have adopted a rather interesting expedient. On each side of the motor, and fitted to the same bed plate, two centrifugal pumps are mounted, the fans of which are keyed on the armature shaft of the motor. The whole four of these pumps are mounted in series, that is to say, the discharge pipe of the one pump is connected to the inlet of the other, so that the final difference of head between inlet to the first pump and the discharge pipe of the last, is the sum of the heads due to the four pumps taken separately. The plant in question was supplied to the Altai Mines, and the total lift is about 160 feet. We do not know what the efficiency of the plant has proved to be, but the arrangement is certainly very compact. —*Engineering*.

Taps and Dies for Birmingham or Stubs' Gauge.

The development of the bicycle and electrical industries has brought about a considerable demand for taps and dies to suit the Birmingham or Stubs' wire gauge, and the fact that orders for such sizes have been considered "special" has, of course, been regarded as a hardship by repairers and others who have use for such sizes.

The Wiley & Russell Mfg. Co., of Greenfield, Mass., have now, however, concluded that the demand is sufficient to justify them in manufacturing these sizes and supplying them in sets in the regular way, put up as shown by the accompanying illustration, containing 5, 10 or 15 sizes and pitches of taps and dies, according to requirements. In connection with these full information is published by the manufacturers, in regard to comparisons with U. S. gauge, absolute sizes, sizes of tap drills, etc.

SET WITH 5 BIRMINGHAM WIRE GAUGE SIZES AND TAP WRENCH
SET 6 LIGHTNING STOCK 6 IN LONG
SET WITH 10 BIRMINGHAM WIRE GAUGE SIZES AND TAP WRENCH
SET 0 LIGHTNING STOCK 6 IN LONG
SET WITH 15 BIRMINGHAM WIRE GAUGE SIZES AND TAP WRENCH
SET 0 LIGHTNING STOCK 6 IN LONG

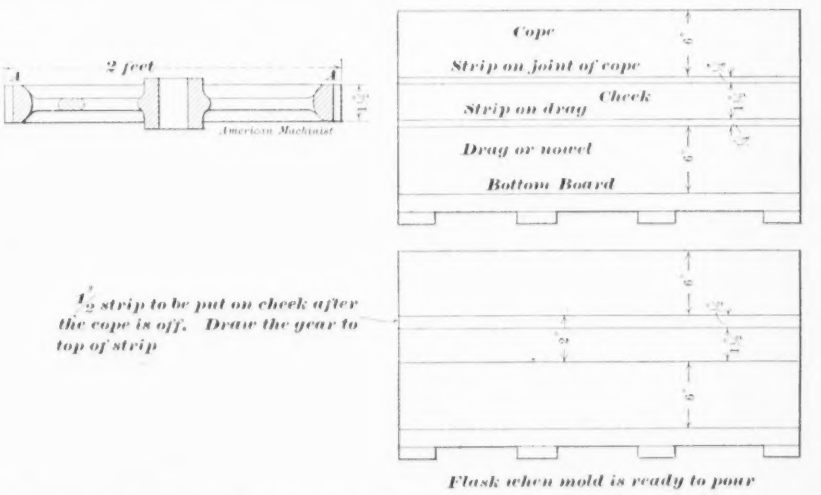
Molding a Gear With Width of Teeth Greater than the Pattern.

BY L. C. JEWETT.

Something happened a few days since, and I thought you might be pleased to hear of it, "to wit," an idea struck me.

It was required to cast a spur gear, and draw it from 1½-inch to 2 inch face; to draw a gear with plain, deep arms and straight rim is quite a simple operation, and is well known to all molders familiar with molding of gears, as well as cutting down the face of spur gears. But this gear had not the common, deep arms, etc, but it had oval arms, and then inside of rim was a convex surface taking in its entire depth. The demand of the customer was to have the arms in the center of rim, and the hub same length as pattern. The increased face of the teeth or rim was the thing wanted, and no other change.

Flask when rammed up with pattern in before opening


2 feet
American Machinist
Cope
Strip on joint of cope
Check
Strip on drag
Drag or nowel
Bottom Board
½ strip to be put on cheek after the cope is off. Draw the gear to top of strip

Flask when mold is ready to pour

The sketch will assist in explaining the *modus operandi*.

Select a flask with good, straight joints, put strips ¼ inch thick on the joint of the drag or nowel sweep of a bed—even with this joint, put pattern on, tuck up the arms and hub.

Have a cheek just the depth that pattern is before being drawn—put this on drag or nowel and tuck up teeth and ram up, and make the joints between arms, etc., ready for cope.

Put on the joint side of cope strips ¼ inch thick with screws, then put cope onto cheek and ram that up. Remove cope and turn upside down, take off the ¼ inch strips on the joint of cope and sweep or shave off the surplus sand on the outside up to the point marked *A*, thereby making a new joint on the cope, lowering the arms' center ¼ inch.

Now put on the upper joint of cheek ½ inch strip and draw the pattern to the top of the top joint of cheek as now made.

Take cheek off and remove the ¼ inch strips that were first put on the joint of drag or nowel and remove the surplus sand up to the same point that we did with the cope, sleeking up and finishing the mold in a neat manner, then return the cheek to place on nowel, and there will be an increased face of gear and the arms remaining in the center, and everything done quicker and better than in any other way. This method may have been used by others, but I never heard of it, and I have heard expert molders say that a spur gear with flat, oval arms could not be drawn and have arms in the center. This method will apply to any width of face wanted by putting one half the amount of draw on cope and nowel, and whole amount on the cheek.

Dealers and Consumers.

A well known firm of supply men write us as follows :

A few days ago we had occasion to quote a price to one of our customers on some wire rope, and we are informed by them that they can buy the rope for less money direct from the manufacturer, and we were shown a quotation, and found it to be identical with the quotation made us by the manufacturer. We wrote to the rope maker, and his representative called upon us, and informed us that our customer was *a dealer*, for the reason that he uses this wire rope on a certain machine which he sells. He buys this rope in 1 000 feet coils, and the list price on it is ¾ cent per foot. It seems to us just as reasonable that the screw makers should say that the manufacturer of a certain machine should be classified as "a dealer," because he buys these screws to put onto his machine which he afterwards sells. If we carry this same line of argument a little farther, why not say, that a man who uses machinery steel, cold rolled shafting or belting on any of his machinery which he sells, should be classified as "a dealer" in these lines of goods, and be given the same discounts that the legitimate dealer is getting. Here is a liberal construction which we had not run across before, and we submit it to you and your leaders.

An iron railroad tunnel has just been completed on the North British Railroad near Glasgow. It is known as the Mound North Tunnel, and is a tube of cast-iron 17 feet 6 inches in diameter, composed of segments 4 feet long and 18 inches in breadth, bolted together through flanges 7 inches deep and 1¾ inches thick.

A School of Electricity.

We have received the prospectus of The National School of Electricity, which, with headquarters at Chicago, proposes to establish a class "in every city and town where the population will justify it."

In the prospectus it is said: "The course is intended to cover a period of 40 weeks, with one new lesson for each week. . . .

"The lessons will be short, and in language that students of most limited education can readily understand.

"For each week of the course a 'lesson leaf' will be issued, one at a time, that will contain all information necessary to a complete understanding of one subject. After the first lesson, the 'leaf' will also contain questions upon the lesson of the previous week, calculated to fix the main points in the student's mind. The lessons will be accompanied by drawings sufficiently explanatory, and classes will be furnished with the simpler forms of apparatus for experimental work, and for class demonstration. Blackboard work by the instructor will also enter largely into the system of teaching.

"No technical phrases or electrical terms will be employed until they have been taken up in regular course and mastered. Nor will algebraic equations nor geometric symbols be used, inasmuch as many of our brightest men and boys have been deprived of all but the most limited education. In carrying out these intentions it will be necessary, of course, to depart widely at times from the lines laid down in the text-books, as these invariably assume an advanced education on the part of students.

"Only those things will be taught that are backed up by the highest scientific authority, but it will be the endeavor not to confuse students by citing vast arrays of testimony in support of theories and practice."

J. Allan Hornsby, Monadnock Block, Chicago, is secretary of the corporation.

Japan Manufacture.

In an interesting article on Japan, by C. Wood Davis, in *The Sun*, it is pointed out that when that country was opened to Western trade it was believed that an outlet had been found for immense quantities of European and American goods. Now, however, Japan is manufacturing nearly everything needed by her people, and not only this, but is exporting considerable quantities of manufactured goods. After mention of a large list of articles manufactured in Japan, the writer concludes:

In addition to the articles named Japanese manufacturers now nearly or quite meet the demand for fireproof safes, leather, cement, electric supplies, boots and shoes, hats and foreign styles of clothing so dear to the heart of the Europeanized Jap, saddlery, coaches, paints, upholstery, passenger and freight cars, commercial fertilizers, and a vast array of small wares that were formerly imported. Progress is shown in the manufacture, use, and exportation of cigarettes.

During the last five years exports of the hand-woven silks of Japan have increased 375 per cent.; those of paper, much of it made by the best American and European machinery, some 77 per cent.; matches, 170 per cent.; glassware, 600 per cent.; leather, 700 per cent.; boots and shoes, 127 per cent.; and sulphuric acid, 64 per cent.

The substitution of machine-made wares of domestic manufacture for those formerly imported, and the exportation of the surplus of machine-made goods have resulted in turning the balance of trade in Japan's favor, and the foreign debt of the nation being less than $5,000,000, the drain of specie has wholly ceased, leaving the Japanese in excellent condition to contest the markets of the far East with America, Europe, and India.

So progressive is this old-young nation, and so much inclined to adopt any obvious improvement, that its intention is to use the metric system of weights and measures.

The western world must face the competition of this new member of the industrial commonwealth, soon to be fully armed with the best of modern appliances and processes, that is favored by the lowest of all wage scales, that has an abundance of most efficient labor, and that is not handicapped by excessive taxation.

MANUFACTURES.

At Montreal, Canada, all the shops on the Grand Trunk system have closed.

Lack of coal compels the David Bradley Manufacturing Co., Chicago, to close down.

Lack of coal has compelled the Norton Iron Works, Ashland, Ky., to bank the fires.

A portion of the electrolytic works at Central Falls, R. I., have been shut down for lack of coal.

The Sterling Steel Co., at Demmler, Pa., now has every department running full except the hammer shop.

After a shutdown of several weeks the Tudor Iron Works, East St. Louis, have resumed operations.

Owing to scarcity of coal at Bellefonte, Pa., the Valentine Furnace Company have banked their furnaces.

The Thomas Furnace at Niles, O., will start as soon as coke is available, and will run on Bessemer.

Under the name of the DeKalb Co., the old Ft. Payne (Ala.) Rolling Mill Company has been reorganized.

Operations have begun on the foundation for the addition to Spence, Boggs & Co.'s foundry at Wheeling, W. Va.

The Tonawanda (N. Y.) Iron and Steel Co. has run out of coal and its furnace is banked until coke can be procured.

The Foundry of the Lexington Iron Co., at Lexington, Ky., is being enlarged so as to make room for more machinery.

The Totten & Hogg Foundry of Pittsburgh, Pa., has recently received a large order of steel and will run its works full time with increased force of men.

There is rejoicing in Lynn, Mass., because the General Electric Co. has decided to continue work in the West Lynn factories upon street railway motors.

The Sylvan Steel Co. has now organized on a firm basis and it is definitely decided to erect large works at Davenport, Ia. Geo. W. French is president.

The Saco water-power machine shop at Saco, Me., will resume operations early in June. The shop, which employs 500 hands, has been idle nearly a year.

The Galvanized Iron Working Co., has been formed by D. R Jenkins and others in New Castle, Pa., with capital of $15,000 and works will be erected shortly.

The Baker Forge Co., at Elmwood, Pa., is planning to make additions of a new building to its plant and will put in new machinery for iron working purposes.

It has been definitely decided by officials that the locomotive repair shops of the Wisconsin Central road will not be removed from Waukesha, Wis., to Stevens Point.

The Cleve Smelting Co., for the purpose of manufacturing metal, has been formed in Cleveland, O., recently, by C. V. Byron and others, and the capital is $10,000 all paid in.

The new plant of the McKee Bros., Jennette, Pa., will consist of three large buildings. They will be fire-proof, and built with all modern conveniences. The cost will be $100,000.

Negotiations are pending for the erection of a sheet-mill at Houstonville, Pa., that will give employment to about 50 men. The plant will be 60x300 feet, and will cost about $25,000.

WATER REDUCING VALVE

for use in reducing water pressure in street mains for domestic service. Simple and reliable.

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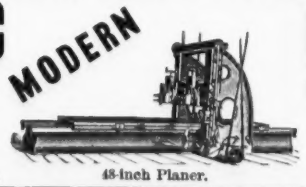
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FITCHBURG, MASS.

BORING AND TURNING MILLS.
37, 51 and 62-Inch Swing, with Two Regular Heads.
42-INCH SWING, WITH TURRET HEAD, AND SCREW CUTTING ATTACHMENT.
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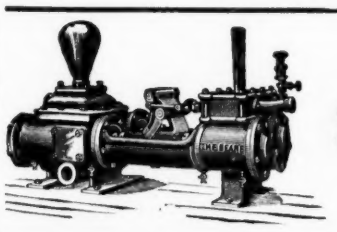
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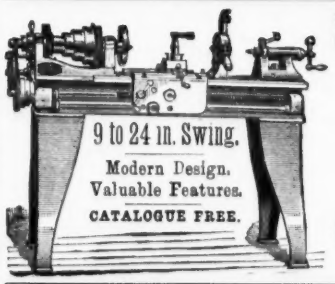

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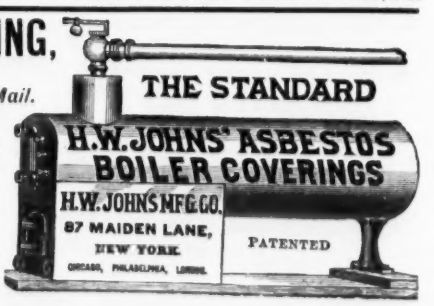

The mills of the new iron company in Waukesha, Wis., are about ready for the machinery. Already several pieces have been shipped to the plant. The works will start up about August 1st.

Improvement in business warrants the McCullough Iron Co., of Wilmington, Del., in putting their rolling-mill at Rowlandsville, Md., in operation again. About 60 men will be given work.

The Hill-Clutch Company, of Cleveland, O., has been incorporated with a capital stock of $50,000, by Messrs. H. W. Hill, Frank Billings, Samuel E. Williamson, John G. White, and T. A. McCaslin.

Work is being pushed on the new plant of the Youngstown (O.) steel works. The daily output is expected to reach about 500 tons of billets at the start, but this will be increased until it reaches about 1,500 tons.

The wire-nail makers of Pittsburgh, Pa., have agreed to advance the price of wire nails 10 cents a keg and pledged themselves to maintain the increased price. Carnegie's were invited but refused to attend the meeting.

Warner & Swasey, Cleveland, O., are building an addition to their works which will double the present capacity. The new shop is being built in the most substantial manner. This company is not finding itself very seriously affected by "hard times."

We have received a finely printed and bound catalogue of machine tools built by John Bertram & Sons, Dundas, Ont. A very complete line of machine tools are illustrated by half-tone engravings, and the catalogue is a valuable one to all interested in machine-shops

The Kittanning (Pa.) Iron and Steel Company was granted a charter a few days ago for the manufacture of iron and steel. The capital stock is placed at $350,000, and is held by James Mosgrove and John A. Colwell, of Kittanning, and Charles T. Neale, of Pittsburgh.

The Rockwood Manufacturing Company, Indianapolis, Ind, is having a very fair run of business. Thus far this year it has built 20 iron bridges for county roads in Illinois and Indiana, and in the last few days has contracted to build 15 more. This firm in 1893 built 115 bridges varying from 10 to 80 feet in length.

A representative of an English syndicate recently offered $7,000,000 for the plant of the Elgin National Watch Company, at Elgin Ill., and President Avery has notified stockholders that three-fourths of the owners of stock have agreed to sell A few years ago $8,000,000 was offered for the plant and rejected.

The Bodwell Water Power Company, J. W. Harmon agent, Oldtown, Me., have recently put in a new hoisting arrangement for raising the gates. It was made by the Bangor Foundry and Machine Company, of this city, and works very satisfactorily. With this device one man does work which formerly required four or five.

The Mechanic Falls Water and Electric Light and Power Company has been organized at Mechanic Falls, Me., for the purpose of furnishing water, light and power. The capital stock is $75,000, and the officers are, President, A. J. Weston, of Mechanic Falls; treasurer, J. H. DeCoster, of Mechanic Falls. The company will put in a plant at once.

The effects of the coal strike at Braddock, Pa., has caused suspensions that have forced more than 3,500 men out of work. The Braddock wire-mill, employing nearly 1,000 men, was forced to suspend several days ago; also the Duquesne forge, at Rankin. The Pittsburgh wire-mill has closed down and 500 more men are thrown out of work.

The well-known Corliss steam-engine works, at Providence, R. I., has been acquired by a company to be known as The Corliss Steam Engine Company. The new company, with which are connected many well-known mechanical and executive men, will continue the manufacture of steam engines and boilers on the lines laid down by Mr. Corliss, having retained the heads of departments employed and trained by him.

The Springfield (Mass.) *Republican* says: Several of the large mills are feeling the scarcity of coal suitable for use in furnaces, and it is said that some of them will be obliged to shut down soon if there is a falling off in the water supply. The mills that have used bituminous coal altogether in their furnaces have been put on short supplies, and several of them have been obliged to use hard coal in larger sizes to make the supply last.

The Williams Typewriter Company is now employing about thirty men, and is increasing the number of employes every week. Mr. Williams says that he finds among those from this vicinity who apply for work the very best kind of workmen, and particularly those who apply for the positions of skilled workmen. The toolmakers who have been employed have shown that they understand their business thoroughly.—*Ansonia* (Conn.) *Sentinel.*

Dean Brothers, Indianapolis, Ind., have received three carloads of heavy machinery from the East for their new shops on First street and the Big Four tracks, and will receive two more carloads in a few days. It is the intention to have these the model shops of the West. They have their pay roll again up to over 100 hundred men, but are not pressed with orders. The strikes, coupled with so many manufactories still being shut down, greatly limit the demand for steam pumps, but they hope that by the time their new shops are completed the troubles will be largely over.

The New Process Raw Hide Company, Syracuse, N. Y., send on request, a catalogue and price list of noiseless, solid raw-hide gearing—spur, bevel and friction—mallets and chisel handles, washers, etc., and "new process raw hide" for any purpose. This company, when first starting in business, found its work largely in substituting raw-hide gears for others that were noisy and objectionable, but gradually the business has grown more in the direction of furnishing gearing outright for new construction. There is a long list of gears in the catalogue, several pages of testimonials and a page devoted to the advantages of these gears—superior lasting qualities, etc. Those who as engineers or mechanics are interested in power transmission will do well to write for the catalogue.

Horace G. Young and Robert C. Blackall, of Albany, Daniel C. Fischel, of Troy, and Charles D. Hudson and Charles L. Mather, of West Troy, have organized a company for the manufacture and sale of an artificial fuel made from coal dust, peat and garbage. It is claimed that it will do the work of the best anthracite coal, can be used for domestic purposes, locomotives and engines, and can be sold cheaper than any other fuel. The

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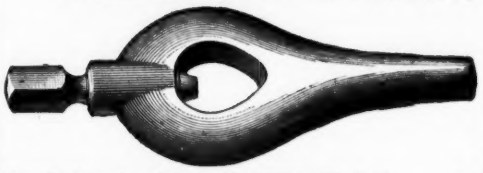

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1¼	.80	13	3½	1.80
5	1½	.80	14	4	2.10
6	1⅝	.95	15	4½	2.75
7	1¾	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set.		31.10

These Goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

C. W. LeCOUNT, South Norwalk, Conn.

BETTS MACHINE COMPANY,
MACHINE TOOL BUILDERS,
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THE BERLIN IRON BRIDGE CO.
Office and Works,
No. 8 Railroad Ave., East Berlin, Conn.
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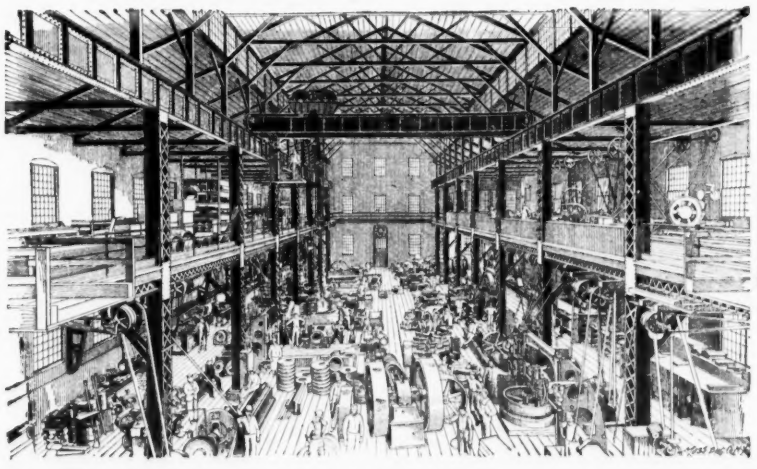
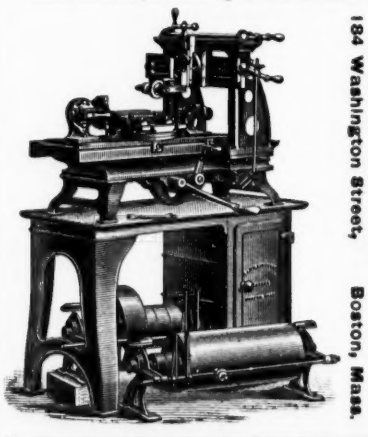


The above illustration is taken direct from a photograph and shows the interior of a Machine Shop designed and built by us for The Ball & Wood Co., at Elizabethport, N. J. The building is 80 feet in width by 180 feet in length. The central portion is 40 feet from center to center of traveling crane rails, while the two-story wings on each side are 20 feet in width. We built this entire building, including the brick work and foundations, the whole complete ready for the machinery.

SEND FOR OUR ILLUSTRATED CATALOGUE.

POWER OR HAND PLANER,
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grad Planers, and is Capable of Doing the Best and Finest Work.



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"Star" Foot Lathe Swings 9x25 in. $85

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Screw Cutting Automatic Cross Feed, etc.

Scroll Saws, Circular Saws, Lathes Mortisers.

Catalogue Free of all our Machinery.

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FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
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Established a century ago.
Medal World's Columbian Exposition 1893.

12" DRILLS. D'AMOUR & LITTLEDALE, 204-206 E. 43d St., NEW YORK.
Correct in Design, Workmanship and Price.
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AGENTS FOR NEW YORK AND VICINITY.

BUILDERS IRON FOUNDRY, Providence, R. I.
STRONGER AND LARGER CASTINGS
Than are furnished by ordinary foundries.
DAILY HEATS FOR WEEK ENDING MAY 26, 1894:
20, 39, 21, 54, 22 and 19 tons.
A good record for quiet times, but we solicit and can handle more orders.

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163 & 165 WASHINGTON ST.,
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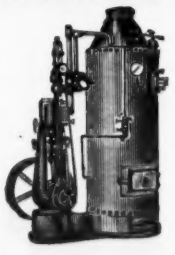
ENGINES and BOILERS.



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Plain and Automatic.
Write fo. Catalogue and mention this paper.

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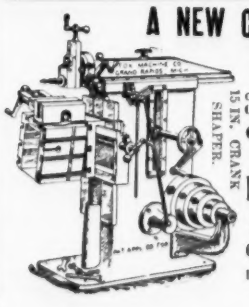
A NEW CRANK SHAPER.



15 IN. CRANK SHAPER.

NOVEL, YET SIMPLE.
Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
Fox Machine Co.,
325 Nor. Front St.,
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135 Finsbury Pavement, London, England.

P.H.& F.M.ROOTS,
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MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.

ROOTS' NEW ACME HAND BLOWERS
Slow speeded, Force-blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt. } 163 & 165 WASHINGTON ST.,
COOKE & CO., Selling Agts. } NEW YORK.
In Writing, Please Mention This Paper.

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PUMPING ENGINE
FOR
WATER WORKS.
SIMPLE, COMPOUND, OR TRIPLE EXPANSION,
HORIZONTAL OR VERTICAL
HIGHEST DUTY GUARANTEED.
COMPLETE DESCRIPTIVE PAMPHLETS ON APPLICATION.
HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.

plant will be established in West Troy, and the company expects soon to be ready for business. The process is the invention of Mr. Fischel.

Surveyors have measured ground in West Bergen, N. J., south of the Newark & New York Railroad, preparatory to the construction of a spur from the railroad, below West Side Avenue bridge, to the woods at the foot of Fulton avenue. At this place a chemical plant is to be set up. Several large buildings will be erected, and the works will furnish employment to probably 300 men. The company about to open business in West Bergen is said to be the Butterworth & Judson Acid Company, the works of which on the Hackensack were burned down recently Eleven acres of ground have been obtained for the new works. This includes property to be traversed by the railroad.—Jersey City *Evening Journal.*

Machinists' Supplies and Iron.

NEW YORK, June 2, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.00; No. 2, $11.25 to $12.00; Gray Forge, $10.25 to $10.50. Southern brands are quoted at $11 50 to $12.25 for No. 1 Foundry; $10.50 to $11.00 for No. 2, and $10.00 to $10.25 for No. 3.

Antimony—The market is steady and quiet. We quote L. X., 9¼c. to 9½c.; Cookson's, 10c. to 10¼c.; Hallett's, 8.62½c. to 8.70c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 59c. to 61c.

Copper—The market is unsettled, and holders of Lake Copper scarcely know what to quote; in a nominal way they are asking 9.30c. Casting Copper is held at 8.80c. to 8.90c.

Lead—The market is quiet, 3.30c. is quoted for New York delivery. There are buyers at 3¼c., but holders hesitate to shade 3.30c, at which price 200 tons have been sold.

Spelter—The market is nominal at 3.40c. to 3.45c. for prompt New York delivery, but less may buy if bids are made.

Tin—The market is dull. Small lots are selling at 20c. and future business can be done at less.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Exp. machinist desires sit. A. H., AMER. MACH.

Draftsman, designer, with practical shop exp., age 25, desires position. O. K., AM. MACHINIST.

First-class mech draftsman wants pos.; mach. tools and gen'l mach'y. Box 77, AM. MACHINIST.

Wanted—Position by a young, all-round mach. or as station'y eng'r; good refs. Box 92, AM. MACH.

Wanted—Mech. draftsman (Swede) wants position. Address U. M., AMERICAN MACHINIST.

Mech. draftsman, tech educat'n, 2½ yrs. exp. on gen. mach'y, wants pos. Box 95, AM. MACHINIST.

Wanted—A first-class engine builder to take charge of that department in a machine shop. Address "A," AMERICAN MACHINIST.

Young man, age, 22, wants position in machine shop where he can learn the trade. Address E. B. Ludwig, Sabetha, Kan.

Wanted—A first-class patternmaker on heavy machinery and gearing; must be a man of good habits. Address Farrel Foundry and Machine Co., Ansonia, Conn.

Experienced superintendent of machine shops and foundries desires an engagement to take charge of works; member of A. S. M E. Address A. W., AMERICAN MACHINIST.

Wanted—By a mach. of 20 years' exp. in erecting and selling steam and electric mach'y; correspondence solicited with mfg. company. Address Advanced Methods, Box 94, AMERICAN MACHINIST.

A mechanical engineer with experience in designing special machinery and tools for manufacturing purposes, wants a position for a few months. Address J. D., AMERICAN MACHINIST.

Draftsman and vise hand; graduate of a technical school in Germany; have some experience in designing; wishes position in drawing-room or shop. Address H. F., 15, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F. A. Welles, Milwaukee, Wis.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

Wanted—To buy a small machine shop and repair shop. Box 93, AMERICAN MACHINIST.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Do you want a picture of the famous Locomotive "999?" Send 50 cents for our fine copper plate *transparent* picture (14x28), showing all parts *inside* and *outside*, all named and numbered, on satin gloss paper, for framing, educational, beautiful, correct. Locomotive Engineering, 256 B'way, N.Y.

A Good Investment—A profitable and well established manufacturing business in the implement line, wants a partner with from $5,000 to $10,000 to be put into the business as additional working capital, in one of the most beautiful and favorably located towns in the Northwest; a rare chance for the right man. Address Box 84, AM. MACHINIST.

Wanted—A party to make and sell on a royalty, a new design of hot water heater temperature regulator; it costs about $2.50 to make, and will sell for $10 to the trade; any machine shop can make it, but a competent selling agent must be employed; from 3,000 to 4,000 ought to be sold annually. Address Box 88, AM. MACHINIST.

CLEVELAND TWIST DRILL CO'S. GRIP SOCKETS.

No More Twisted Tangs.

Larger drills can be used with smaller shanks than ever before. No charge for the groove in the shanks.

Send for Descriptive Price List.

Cor. Lake and Kirtland Sts., Cleveland, Ohio.

Lathes, Planers, Drills, Shapers,

Boiler Tools, Steam Hammers, etc.

Now remaining unsold in the Engine and Boiler Shop, will be closed out at once.

IRON PLANERS.
19 in. x 3 ft. Wheeler.
20 " x 4 " Lathe & Morse.
24 " x 4 " Blaisdell.
24 " x 5 " New Haven.
24 " x 6 " Powell "Latest."
26 " x 8 " Pease.
30 " x 10 " Pease.
32 " x 6 " Pease.
32 " x 6 " Wood Light.
36 " x 10 " Gleason.
60 " x 24 " Heavy Pattern.

SHAPERS.
6 in Stroke, Crank.
8 " " Gould.
9 " " Hewes & Phil.
15 " " Hendey.
16 " " Gould & Eber.
22 " " Triple Geared.

DRILLS.
22 in. Swing Prentice.
26 " " Lodge & Davis.
26 " " " Fric. Pulleys.
36 " " Cinti complete.
48 " " Old Style.
Radial Drill, 86 in. complete.

MILLING MACHINES.
B & S No. 1 Universal with Cutters, Arbors, &c A1 order.
Garvin No. 3 Bk. Gears auto. fd.
Cincinnati No. 2 Bk. Gs. auto. fd.
Pratt & Whitney, "Lincoln."

ENGINE LATHES.
12 in. x 6 ft. Reed.
13 " x 6 " Blaisdell.
14 " x 6 " Reed.
16 " x 6 " New Haven.
16 " x 6 and 8 ft., Ames.
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20 " x 10 " Fitchburg.
24 " x 7 " Otis
24 " x 12 " Putnam.
30 " x 10 " Prentiss Taper.
32 " x 16 " Gleason.
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84 " x 18 " Lincoln.
Pit Lathe, 72 in

HAMMERS.
50 lb. Helve, Bradley, Up'g't.
300 " Steam, Ferris & Miles.
800 " " "
1200 " Drop with Lifter, Farrel F'd y's Make.

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SUCCESSOR TO E. P. BULLARD'S
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ENGINE LATHES.
1 12 in. x 5 ft. G. Gage.
1 14 " x 6 " Bogart.
1 15 " x 6 " Flather.
1 15 " x 8 " Fitchburg.
1 16 " x 6 " Perkins.
1 16 " x 7 " Bement.
1 16 " x 6 " F. E. Reed.
1 18 " x 6 " New Haven.
1 18 " x 8 " Pease.
1 20 " x 6 " Bullard.
1 24 " x 14 " Dexter.
1 29 " x 12 " Fifield.
1 37 " x 14 " Old Style.
1 26 " x 25 " L. W. Pond.

PLANERS.
1 16 in. x 16 in. x 3 ft. Belden.
1 22 " x 22 " x 4 " L.W.Pond
1 24 " x 24 " x 7 " N. Haven.
1 24 " x 24 " x10 " Pease.
1 28 " x 28 " x 7 " N. Haven.

DRILL PRESSES.
2 10 in Milliken Bench.
1 10 " Gardam Sensitive.
1 10 " Slate 3 Spindle.
1 No. 1 Garvin 2 Spindle.
1 " 2 " 3 "
2 " 3 " 4 "
1 20 in New Haven Bench.
1 24 " Cincinnati.
1 5 ft. Niles Radial.

SHAPERS.
1 6 in. Boynton & Plummer.
2 10 " Juengst Crank.
2 10 " Wood and Light Traverse head.
1 15 in. Juengst Friction.
1 18 " Putnam Traverse head.

SCREW MACHINES.
1 No. 5 Brown & Sharpe.
1 " 3 Windsor.
1 " 2½ Pratt & Whitney.
1 16 in. x 5 ft. Flather & Co.

PUNCH PRESSES.
1 No. 2 Farrell Foundry, Foot.
1 " 3 " " Power.
1 " 5 " " Power.
1 " 6 Niagara, Power.
1 " 31 Eaton, Double Acting.
1 Heavy Screw Press.

MILLING MACHINES.
1 No. 2 Garvin, Hand.
1 " 1½ Garvin, Power.
1 " 2 Garvin, Power.
1 " 0 Garvin, Universal.
1 " 5 Brainerd Standard.
3 Pratt & Whitney, Lincoln.
3 Garvin, Lincoln.
1 F. E Reed, Lincoln.

Also, a large number of other machines. Write for complete list and detailed description.

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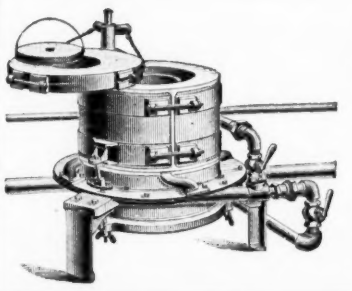
LAIGHT & CANAL STS., NEW YORK
Also 51 North 7th St., Philadelphia, Pa.

Burnham's Sensitive Drill.

SEND FOR CIRCULAR.
THE GEO. BURNHAM CO., Worcester, Mass.



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Gas Blast Furnaces & High Pressure Blowers
For the economical generation and systematic application of HEAT.
CATALOGUES ON APPLICATION.
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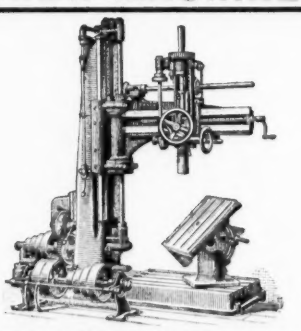
GEORGE PLACE MACHINE CO.

BRASS-WORKING TOOLS.

SPECIAL MACHINERY. PRICES ON APPLICATION.
BARDONS & OLIVER Cleveland, Ohio.
SCREW MACHINES.



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Builders of Upright and Radial Drills.

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Builders of WIRE FORMING MACHINES
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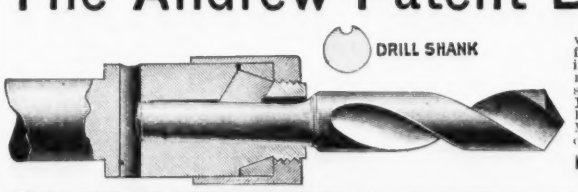
For making articles from the coil, of either round, half round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.
Bicycle and Labor Saving Machinery a Specialty.

The Andrew Patent Drill Chuck.



The original (not copied) device to prevent twisting off Tangs. No extra cost for ANDREW'S reverse incline groove in the shanks. Chucks made direct on new or old spindles. Holds heavy taper-shank tools from dropping out. Best Practical Chuck in the World. Endorsed by all prominent Twist Drill Makers and Mechanical Experts. Send for catalogue.
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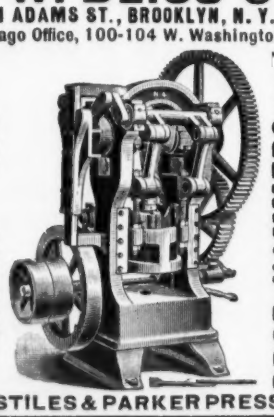

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LARGEST LINE IN THE MARKET

Special Screws and Studs in Brass or Steel.
Gear Cutting, Sheet Metal Stamping, Automatic Machinery built to order. Send sample or drawing for estimate.
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THE CLEVELAND MACHINE SCREW CO.,
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Manufacture Automatic Screw Machines for every variety of work. Samples of the production of these machines sent on application. We have about 200 of these machines at work in our factory, producing parts of Guns, Sewing Machines, Bicycles and Standard Screws
We are also sole owners of and successors to the GRANT ANTI-FRICTION BALL CO. Our facilities in the production of Balls for Anti-Friction and other purposes are unsurpassed in the world.
SAMPLES, PRICES AND CATALOGUES FREE.

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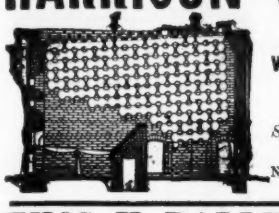

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MANUFACTURERS OF
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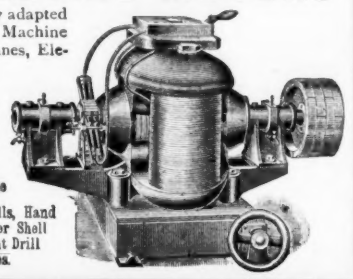
Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses, and other Machinery.



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Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses.

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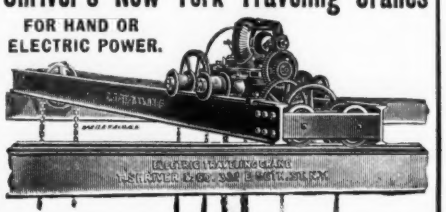
FOR HAND OR ELECTRIC POWER.



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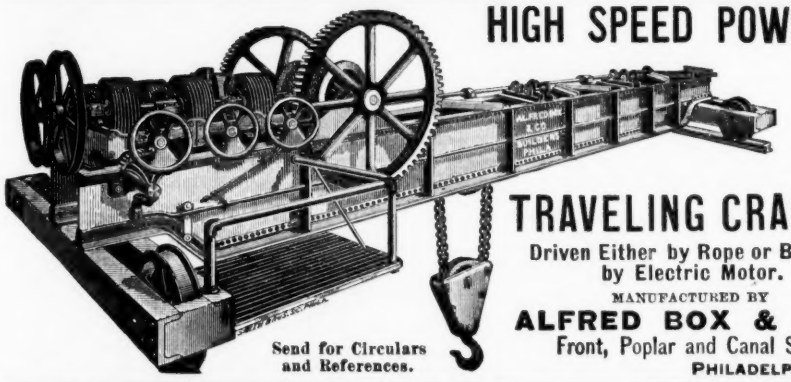

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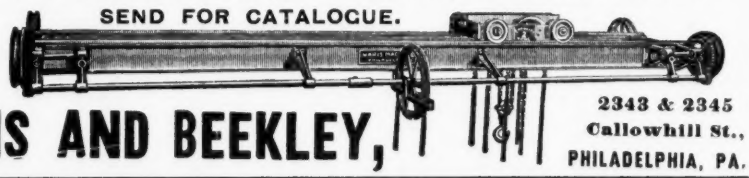

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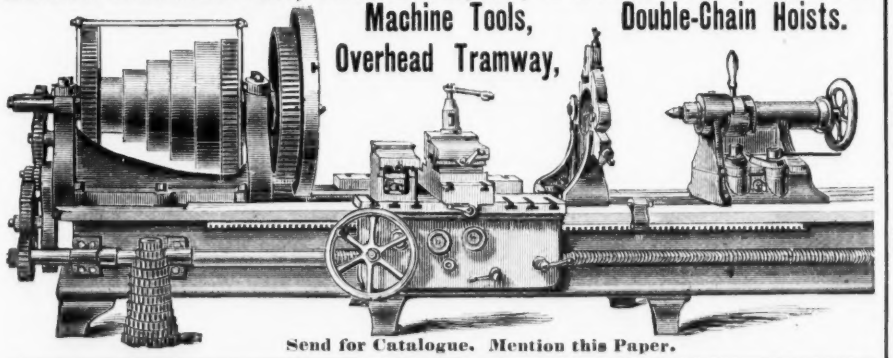

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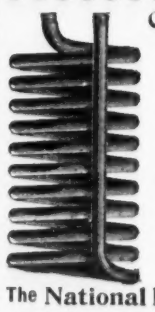

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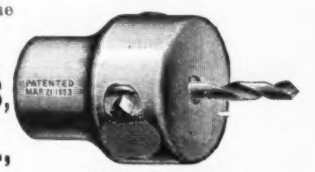

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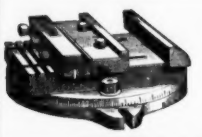

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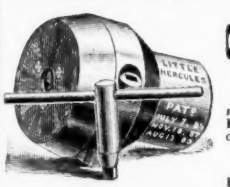

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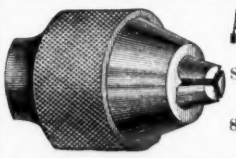

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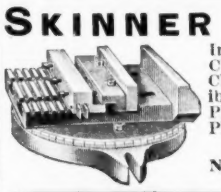

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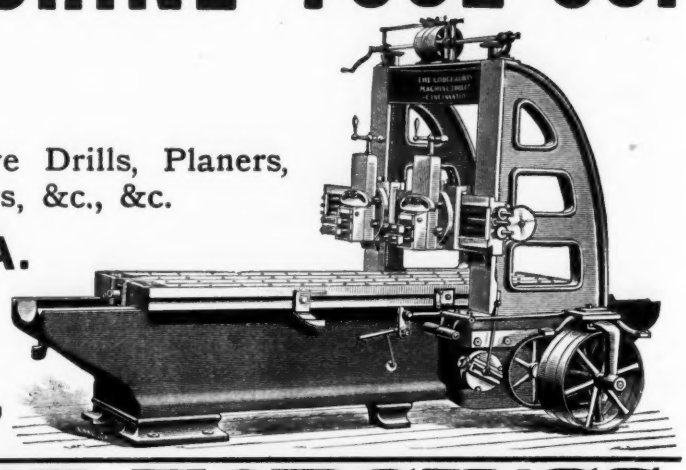

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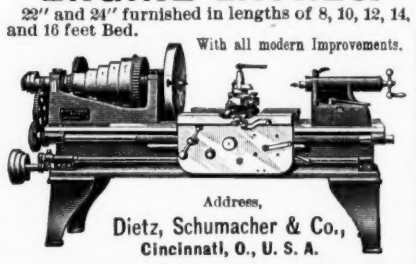

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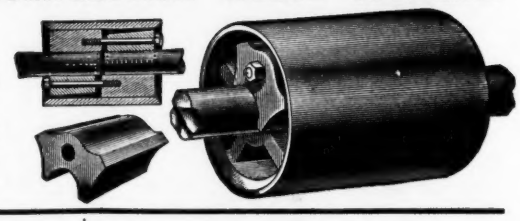

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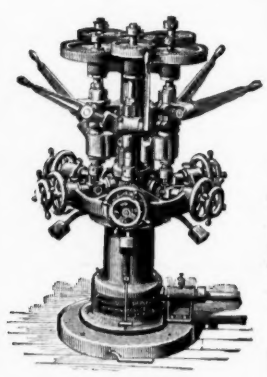

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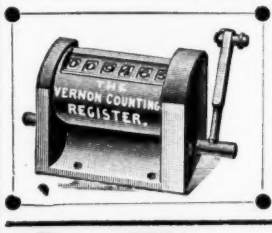

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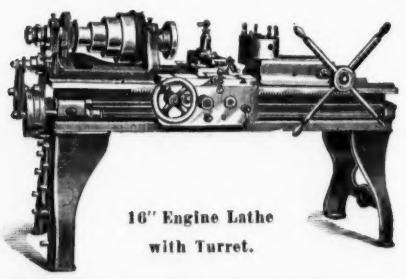

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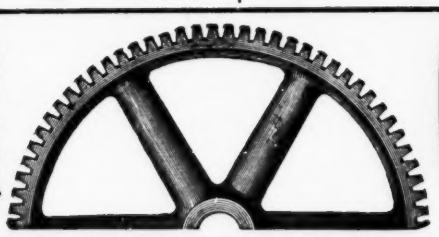

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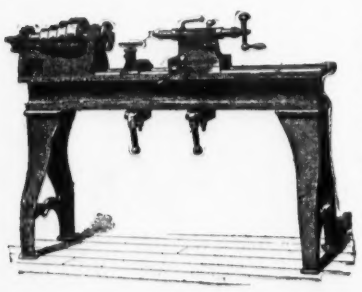

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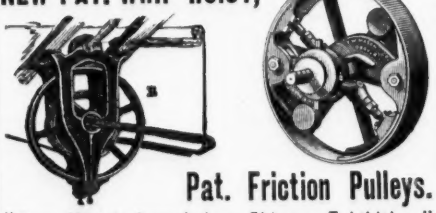

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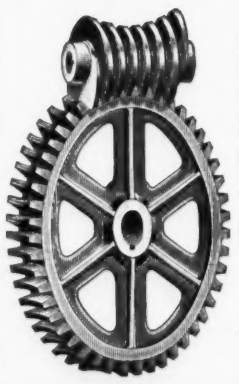

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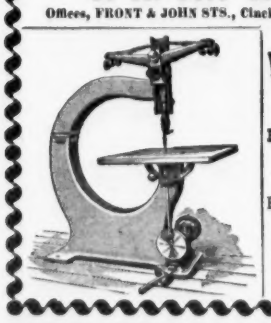

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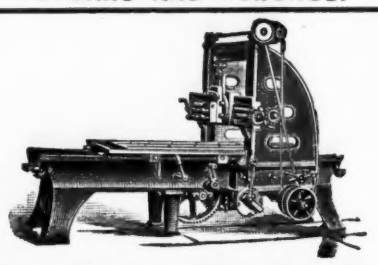

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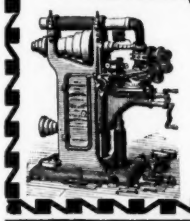

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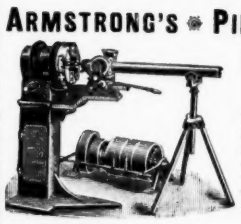

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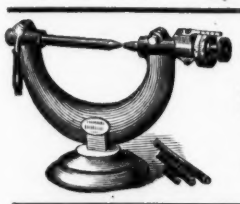

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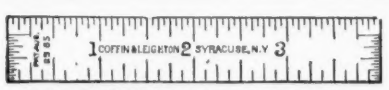

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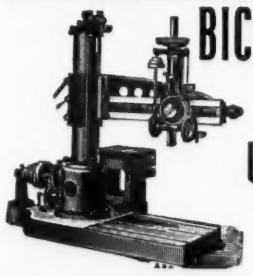

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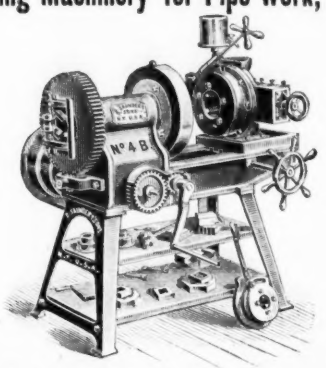

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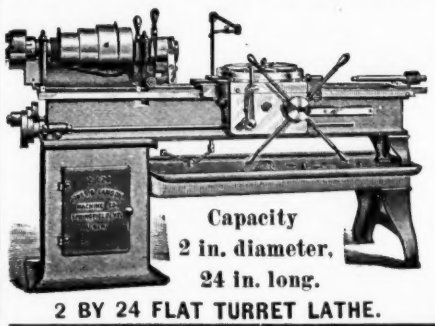

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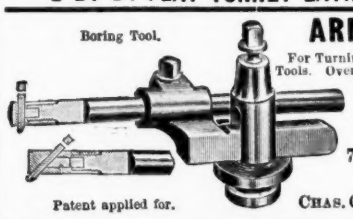

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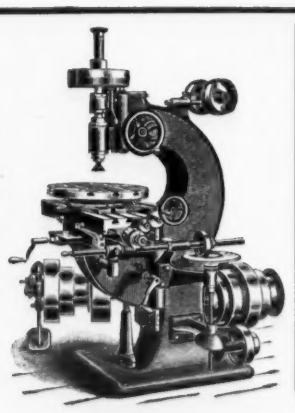

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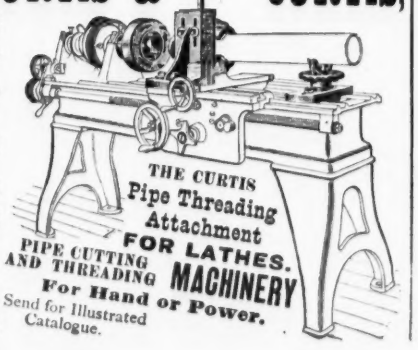

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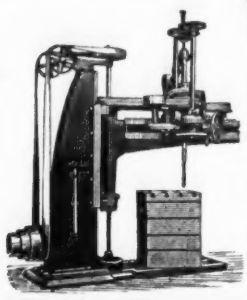

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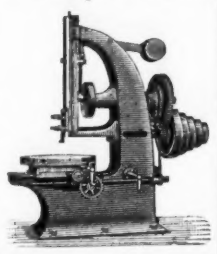

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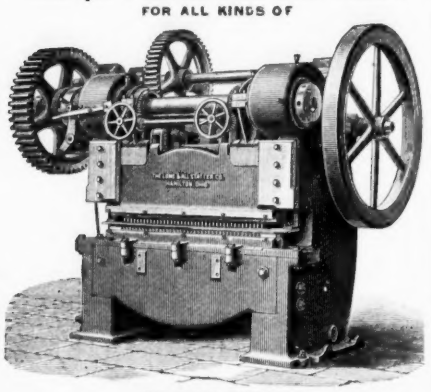

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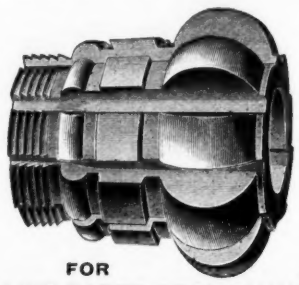

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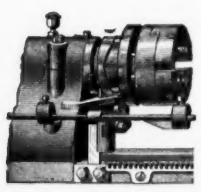

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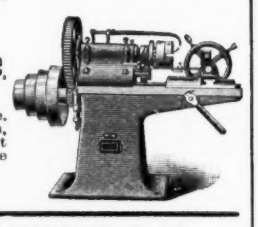

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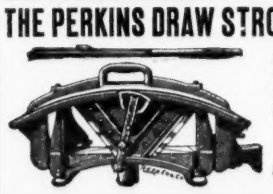

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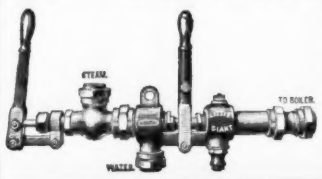

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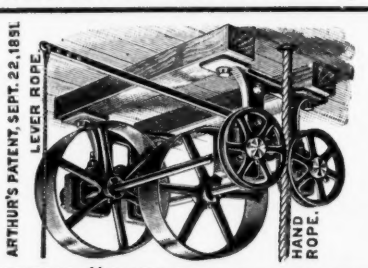

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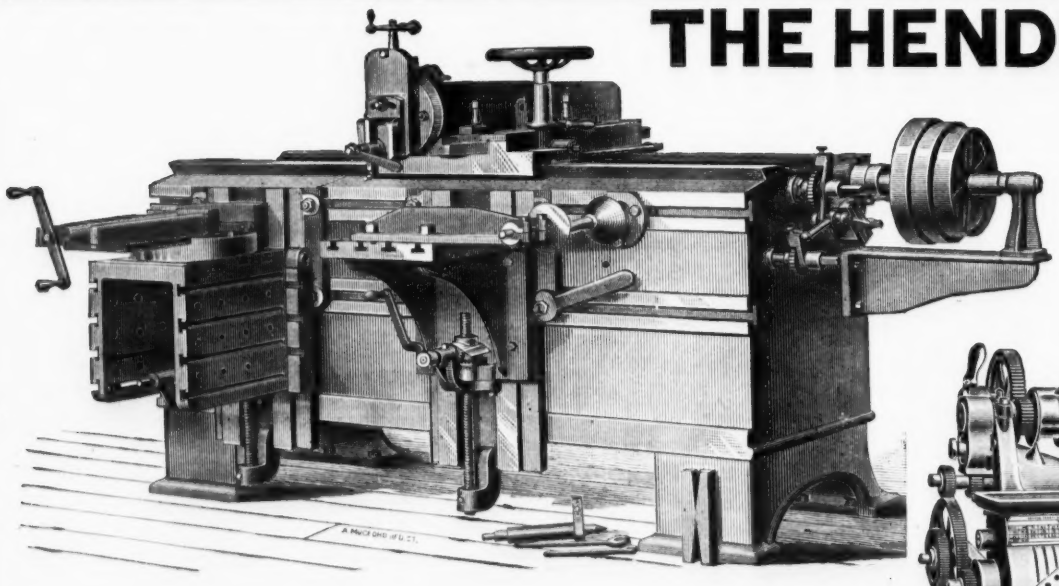

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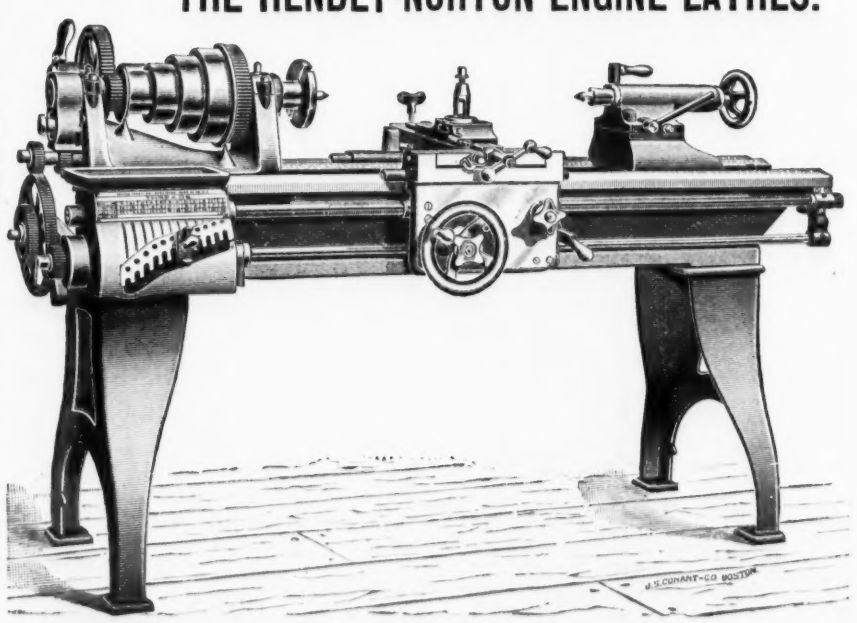

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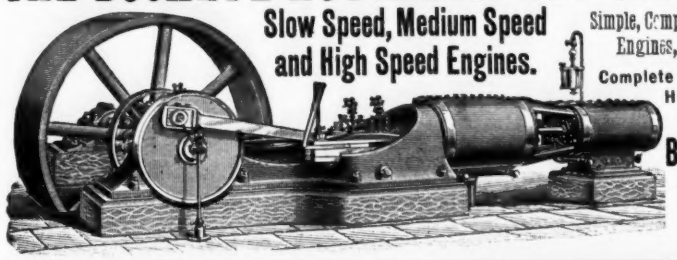

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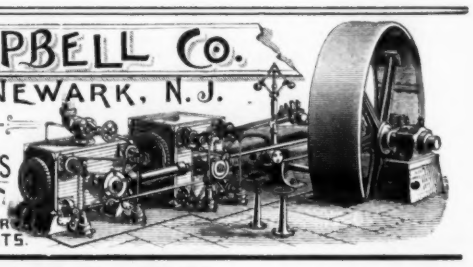

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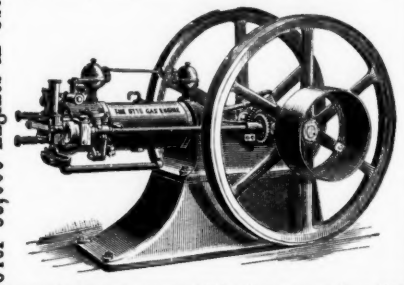

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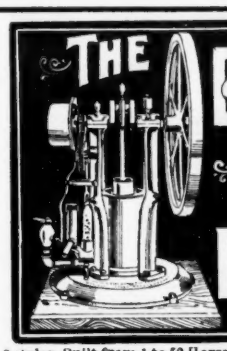

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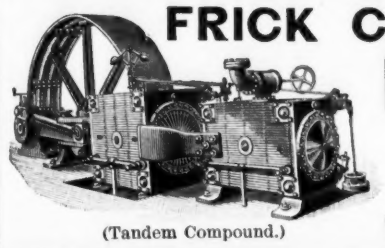

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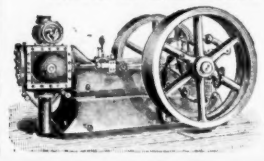

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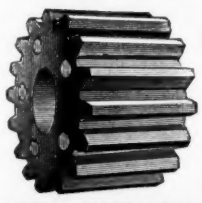

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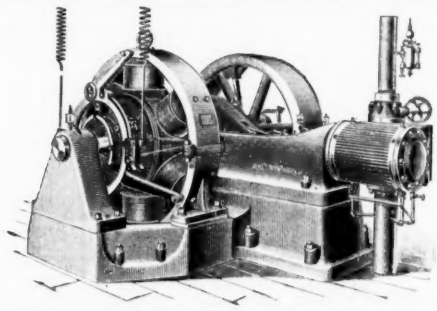

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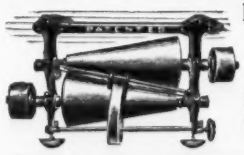

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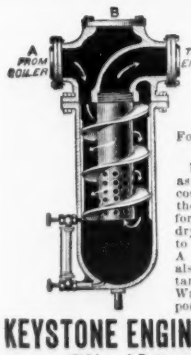

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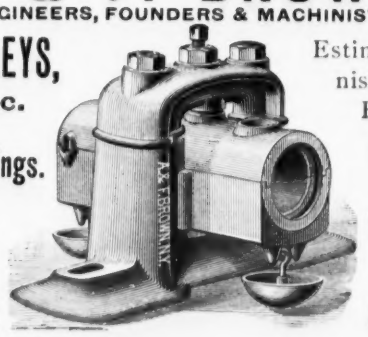

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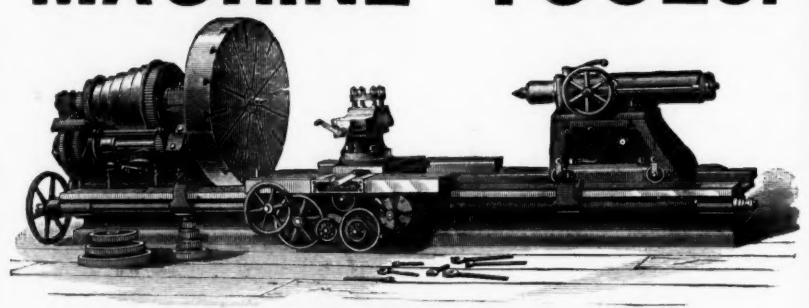

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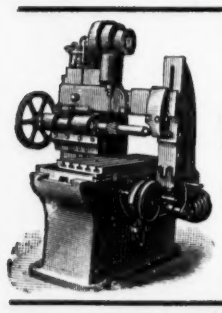

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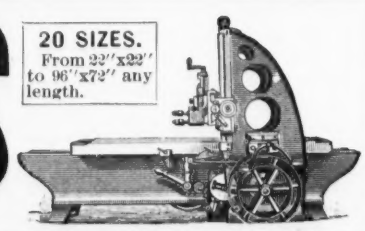

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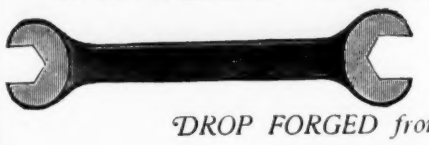

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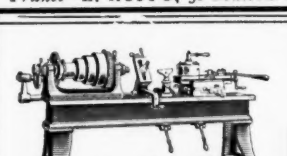

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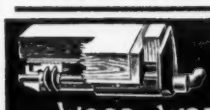

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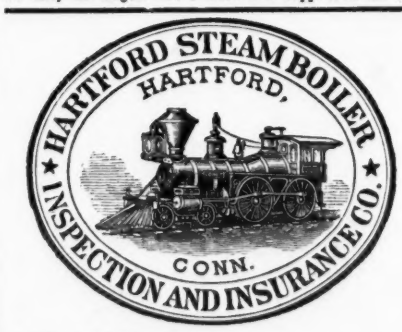

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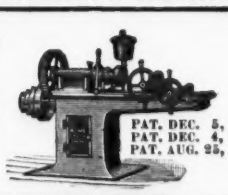

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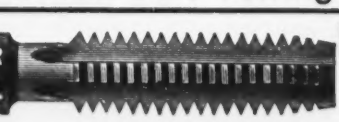

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